

JPRS-CST-94-017  
18 October 1994



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# ***JPRS Report***

# **Science & Technology**

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***China***

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# Science & Technology China

JPRS-CST-94-017

## CONTENTS

18 October 1994

### Science and Technology

#### Science and Technology Policy

Fresh Call for Piracy Crackdown [CHINA DAILY, 5 Sep 94] .....	1
Pirated CDs Banned But Not Eradicated [KEJI RIBAO, 16 Sep 94] .....	1
Special Report China: Direct Foreign Investments Support China's Economic Development Zones [JOURNAL OF ELECTRONIC ENGINEERING, Jul 94] .....	2
Measures to Promote Development of China's High-Tech Industries [JINGJI RIBAO [ECONOMIC DAILY] 3 May 94] .....	6
Beijing University Launches Advanced S&T Personnel Program [RENMIN RIBAO, 9 May 94] ...	7
State to Build Bases for Domestic Production of Major Technological Equipment [ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] 13 May 94] .....	11

#### Advanced Materials and Superconductivity

Further Details on Nanoscale Electrode Inserted into Human Cell [Ruan Xianghua; KEJI RIBAO, 22 Jul 94] .....	12
Preparation of Amorphous SiO <sub>2</sub> -Ag Nanocomposite via Gamma-Ray irradiation/Sol-Gel Method [Zhu Yingjie, Qian Yitai et al.; KEXUE TONGBAO, 1-15 Aug 94] .....	12
Nation Is First to Find Rectifying Contact Formed by Undoped Solid C60, Semiconductor [Bai Zhizheng; KEJI RIBAO, 1 Aug 94] .....	12
Omnibearing Ion Implanter Unveiled [Deng Xianchun, Liu Xiaoge; ZHONGGUO KEXUE BAO, 3 Aug 94] .....	13
Nation's First Cubic Boron Nitride Production Line Operational [Shi Yansong, Lu Yi; ZHONGGUO HE GONGYE BAO, 6 Jun 94] .....	13

#### Biotechnology

In Vitro Cultivation of the Exoerythrocytic Stage of Plasmodium Vivax (Southern China Isolate) [Luo Shuhong, Liu Duo, et al.; ZHONGGUO JISHENGCHONGXUE YU JISHENG-CHONGBING ZAZHI, Vol 12 No 2, May 94] .....	13
DNA Sequencing of Circumsporozoite Protein Genes of Plasmodium Vivax From Four Different Countries in West Pacific Region: Comparative Study on the Flank Sequences [Huang Tianyi, Cheng Qin, et al.; ZHONGGUO JISHENGCHONGXUE YU JISHENG-CHONGBING ZAZHI, Vol 12 No 2, May 94] .....	13
Analysis of the Target Epitopes Recognized by Two Monoclonal Antibodies Directed to Egg-Associated Fractions of Schistosoma Japonicum [Qian Zongli, Lu Ping, et al.; ZHONGGUO JISHENGCHONGXUE YU JISHENG-CHONGBING ZAZHI, Vol 12 No 2, May 94] .....	14
Construction of a cDNA Library of the Erythrocytic Stage of Plasmodium Vivax [Qiu Chiping and Tong Xiaomei; ZHONGGUO JISHENGCHONGXUE YU JISHENG-CHONGBING ZAZHI, Vol 12 No 2, May 94] .....	14
Detection of Specific DNA Fragment of Plasmodium Falciparum by Solid Phase PCR [Yu Yang, He Jianwen, et al.; ZHONGGUO JISHENGCHONGXUE YU JISHENG-CHONGBING ZAZHI, Vol 12 No 2, May 94] .....	14
In Vitro Sensitivity of Plasmodium Falciparum to Mefloquine, Quinine, Amodiaquine, Chloroquine, Pyronaridine and Sulfadoxine/Pyrimethamine in South Yunnan [Yang Henglin, Yang Pinfang, et al.; ZHONGGUO JISHENGCHONGXUE YU JISHENG-CHONGBING ZAZHI, Vol 12 No 2, May 94] .....	15
Molecular Cloning and Sequencing of an Isolate of Hepatitis Delta Virus from Henan, China [Liu Shanlu, Zhan Meiyun, et al.; BINGDU XUEBAO, Vol 10 No 2, Jun 94] .....	15
cDNA Cloning, Sequencing and Expression in E. Coli of the C Region of HCV Genome Derived from Chinese Patient with HCV Infection [Yang Yongping, Xia Ningshao, et al.; BINGDU XUEBAO, Vol 10 No 2, Jun 94] .....	15

Development of a New Type HCV EIA Diagnostic Kit [Yang Yongping, Xia Ningshao, et al.; BINGDU XUEBAO, Vol 10 No 2, Jun 94]	16
Typing of HFRS Viruses in China by Polymerase Chain Reaction [Yao Zhihui and Yu Yongxin; BINGDU XUEBAO, Vol 10 No 2, Jun 94]	16
Overexpression of Recombinant Human Fusion Protein IL-6/IL-2 (CH925) in E. Coli [Zhao Chunhua, Wang Jiayi, et al.; ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI, Vol 14 No 3, Jun 94]	16
Construction of an Aromatic Acid Auxotrophic Attenuated Strain of the Bivalent Hybrid Strain (FS54) of S. Sonnei and S. Flexneri 2A [Liu Shihui, Mao Peiji, et al.; ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI, Vol 14 No 3, Jun 94]	17
Study on Some Biological Properties of the Strain of FS54-7b (an Aromatic Acid Auxotrophic Attenuated Bivalent Hybrid Strain of S. Sonnei and S. Flexneri 2a) [Liu Shihui, Mao Peiji, et al.; ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI, Vol 14 No 3, Jun 94]	17
Purification and Physiochemical, Pharmacological Properties of a New Phospholipase A <sub>2</sub> of Fujian Vipera russelli siamensis Snake Venom [Liu Guangfen, Wang Qingchuan, et al.; SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA et BIOPHYSICA SINICA], Vol 26 No 3, May 94]	17
Preparation of Cross-linked Transferrin-liposomes with Potential Targeting Activity [Yang Jingping, Wang Die, et al.; SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA et BIOPHYSICA SINICA], Vol 26 No 3, May 94]	17

## Computers

Research Project Yields BJ-1 400 MFLOPS Parallel Computer [Chen Xiechuan; ZHONGGUO KEXUE BAO, 25 Jul 94]	13
Mainland to Exchange Information with Taiwan via Internet [Bao Gen; JISUANJI SHIJI, 27 Jul 94]	18
USTND Develops Matrix English-Chinese Machine Translation System [Xiang Hanyuan; JISUANJI SHIJI, 27 Jul 94]	18
Computer-Reproduced Hologram Software Developed [Liu Jun; RENMIN RIBAO OVERSEAS EDITION, 22 Aug 94]	18
Software Deal May Breathe Life into Industry [Li Xing; CHINA DAILY, 3 Sep 94]	18
Super-PC-Based SAR Imaging Processor [Peng Hailiang, Zhu Minnui et al.; DIANZI KEXUE XUEKAN, Jul 94]	19

## Defense Technology

New Methods for Extending Frequency Band of RAM Coatings [Zhao Bolin, Rao Kejin; DIANZI KEJI DAXUE XUEBAO, Jun 94]	20
Domestic GPS-Based Moving-Target Monitoring/Alarm System Certified [Yang Zhaobo; KEJI RIBAO, 5 Aug 94]	21

## Lasers, Sensors, Optics

New Infrared Detectors Developed	22
9-Micron Ge-Si-Si Internal Photoemission IR Detector [Gong Dawei, Lu Xuekun, et al.; HONGWAI YU HAOMIBO XUEBAO, Apr 94]	22
Thin-Film Thermopile IR Detector [Sun Tietun, Zhou Nansheng; HONGWAI YU HAOMIBO XUEBAO, Apr 94]	22

## Microelectronics

Nation's First GaAs 600-Gate Gate Arrays Developed by CAS Institute [Huang Xin; WEN HUI BAO, 24 Aug 94]	23
More on First Domestic 600-Gate GaAs Gate Arrays [Huang Xin; ZHONGGUO KEXUE BAO, 26 Aug 94]	23
State IC Specialized Equipment Development Base Set for Shanghai [Chen Qin; KEJI RIBAO, 19 Aug 94]	23
Further Details on Chinese R&D of Piezoelectric/Electrostrictive Microactuators [Cai Hegao, Sun Lining, An Hui; GAO JISHU TONGXUN, Jun 94]	24

## Telecommunications

More Reports on Information Highway/Mobile Communications .....	24
Fibre-Optic Cable to Improve NW Telecom [Gao Jin'an; CHINA DAILY, 19 Aug 94] .....	24
One Phone for Every 2 Beijingers by 2000 [CHINA DAILY, 25 Aug 94] .....	25
AT&T Increases Presence in Telecom Industry [Liu Weiling; CHINA DAILY, 29 Aug 94] ..	25
IBM Enters Hi-Tech JV to Assist Golden Plan [Pei Jianfeng; CHINA DAILY, 30 Aug 94] ..	26
China To Get into Internet via SprintLink [Li Yan; CHINA DAILY, 31 Aug 94] .....	26
Nokia Has Market Covered Four Ways [CHINA DAILY, 1 Sep 94] .....	27
Quality Services Put Asia Paging Ahead of Field [CHINA DAILY, 1 Sep 94] .....	28
Champion Plans To Expand Paging Network Worldwide [CHINA DAILY, 1 Sep 94] .....	29
Philips Targets China's Growing Telecom Industry [CHINA DAILY, 1 Sep 94] .....	30
NEC Expands Business To Cash In on Market Potential [CHINA DAILY, 1 Sep 94] .....	31
Taihua Markets Miniature Paging System [Bao Xin, Xiao Jing; ZHONGGUO DIANZI BAO, 22 Aug 94] .....	32
East China Building Radio Paging System [Liu Dong; ZHONGGUO DIANZI BAO, 22 Aug 94] .....	32
Mobile Equipment Production Line Operational [Wei Guangdong; ZHONGGUO DIANZI BAO, 22 Aug 94] .....	32
Guangdong Completes Nation's First 622 Mbps SDH Fiber Optic System [Unattributed; RENMIN RIBAO OVERSEAS EDITION, 3 Sep 94] .....	33
Zou Jiahua Addresses Meeting on Information Highway [XINHUA, 12 Sep 94] .....	33
Calls Start on High-Tech Phone Line [CHINA DAILY, 16 Sep 94] .....	33
Global Computer Network Set Up [CHINA DAILY, 16 Sep 94] .....	34
Provinces Linked by Network [CHINA DAILY, 19 Sep 94] .....	35
10-Channel WDM+EDFA Experimental All-Optical Communications System [Xu Anshi, Wu Deming et al.; GAO JISHU TONGXUN, Jul 94] .....	36
Federation of Economic Organizations To Support China's Fiber-Optic Communications Network Project [DEMPA SHIMBUN, 4 Aug 94] .....	37

## Physics

Test of the Saddle Superconductive Magnet for MHD Generator [Yan Luguang, Lin Liangzheng, et al.; DIWEN WULI XUEBAO [CHINESE JOURNAL OF LOW TEMPERATURE PHYSICS], May 94] .....	37
Taiwan: Test Results of INER TR30/15 Compact Cyclotron, Isotope Production Facility [G. Ting, P.S. Song, et al.; HO-TZU K'O-HSUEH, Vol 31 No 1, Feb 94] .....	37

## Energy

### National Developments

Power Output Could Hit 900 Billion kWh in 1994 [Chang Weimin; CHINA DAILY, 25 Jul 94] ..	45
Figures in on Power Production for First Half of 1994 [JINGJI RIBAO [ECONOMIC DAILY], 7 Jul 94] .....	45
Big Four Power Companies Seek More Foreign Investment [Chang Weimin; CHINA DAILY, 23 Jul 94] .....	46
Experimental Rural Energy Plan To Go National [Wang Yonghong; CHINA DAILY, 5 Aug 94] ..	46
Inner Mongolia Now Described as 'Major Energy Supplier' [CHINA DAILY (Economics), 15 Aug 94] .....	47
China's Installed Capacity, Power Output in 1993 [ZHONGGUO DIANLI No 7, 5 Jul 94] .....	47
End of Power Shortage Could Be Seen by Year 2000 [Qu Jian; KEJI XUEBAO [CHINESE SCIENCE AND TECHNOLOGY DAILY], 22 Jun 94] .....	48
Ningxia at Forefront of Nation's Rural Electrification Effort [Wang Cunli; RENMIN RIBAO OVERSEAS EDITION, 16 Jul 94] .....	49
Three Gorges Will Spawn Enormous Markets for Raw Materials, Transportation, Construction and Technology [Huang Xuanchuan; WEN HUI BAO, 19 Jul 94] .....	49
Energy Production, January-April 1994 [ZHONGGUO NENGYUAN, No 6, 25 Jun 94] .....	50
Guizhou Rapidly Developing Local Electric Power [Liu Zengbing; GUIZHOU RIBAO, 7 Jul 94] .....	51
Sichuan Sets Policy for Primary Energy Development [Xiong Dabin; SICHUAN RIBAO, 6 May 94] .....	51



Eastern Fujian Adding More Hydropower Stations [Wang Renmo, Huang Zhongxing; FUJIAN RIBAO, 17 May 94]	52
Accelerated Construction Helps Ease Power Crunch in Southern Fujian [Chen Chonglong; FUJIAN RIBAO, 7 May 94]	52
<b>Hydropower</b>	
First Unit of 510MW Dongfeng Station To Be Operational Soon [CHINA DAILY, 5 Aug 94]	53
Developing the Hydropower Resources of the Jinsha Jiang [Li Zhengjie; RENMIN RIBAO OVERSEAS EDITION, 14 Jun 94]	53
Accelerating Development of Jinsha Jiang Basin Hydropower Resources [SHAANXI RIBAO, 18 May 94]	54
Construction Progressing Quickly on Daxia Hydropower Station [Yan Ming; GANSU RIBAO, 4 Jul 94]	54
Newly Added Hydropower Capacity Sets Record [YUNNAN RIBAO, 6 Jul 94]	55
Electricity Output Rises Sharply in First Quarter [Wei Min; CHINA DAILY, 18 Apr 94]	55
Guizhou's 75,000-kW Puding Station Has World's Tallest Rolled Concrete Arch Dam [GANSU RIBAO, 9 Aug 94]	56
'Big Breakthroughs' Expected in Foreign Investment in Power Sector [Chang Weimin; CHINA DAILY, 18 Apr 94]	56
Computerized Cable Hoist Concrete Pouring System for Use on High Dams [Zhou Zimu; GUIZHOU RIBAO, 4 Apr 94]	57
<b>Thermal Power</b>	
Yuanbaoshan Plant Update [Gao Qingming, Sun Jipeng; RENMIN RIBAO OVERSEAS EDITION, 25 Jun 94]	58
Siemens To Help Build Hebei Power Plant [Wang Baoyuan, Zhang Jinqing; HEBEI RIBAO, 27 Jun 94]	58
Henan Formulates Plan for Small-Scale Thermal Power Development [Yu Liankui, Hao Xincan; HENAN RIBAO, 6 Jul 94]	58
1.2 Million-kW Fuyang Project Passes Feasibility Examination [Shi Wanchun, Li Bao; ANHUI RIBAO, 26 Jun 94]	59
Work Completed on 250MW Weihai Plant in Shandong [RENMIN RIBAO, 18 Jul 94]	59
Waigaoqiao Update [WEN HUI BAO, 9 Aug 94]	59
<b>Coal</b>	
Coal Industry Eagerly Seeking Foreign Funding, Technology [Gao Xinhua; RENMIN RIBAO OVERSEAS EDITION, 11 Jun 94]	59
Coal Resources, Coal Properties, and Rational Coal Production and Consumption in Northeast China Analyzed [Li Wenhua, Qu Jiong; MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] Vol 22 No 5, May 94]	60
Superclean Coal Research and Development [Chen Wenmin; MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] Vol 22 No 6, Jun 94]	63
State Council Approves Henan Coal Gasification Project [Shi Yuanfeng, Zhang Jinling; HENAN RIBAO, 20 Jun 94]	67
<b>Oil and Gas</b>	
Steady Progress Seen in Tarim Oil and Gas Exploration [Fan Yingli, Wang Boyu; RENMIN RIBAO OVERSEAS EDITION, 4 Jun 94]	67
Foreign Firms Begin Exploration in Tarim Basin [Gao Xinhua; RENMIN RIBAO OVERSEAS EDITION, 11 Jun 94]	67
Tarim Exploration Making Steady Progress [Fan Yingli, Wang Baiyu; HEBEI RIBAO, 27 May 94]	68
Breakthrough in Deep Drilling at Zhongyuan [Qiu Guoqiang, Huang Xijing; HENAN RIBAO, 9 May 94]	68
Dagang Shallow Well Hits Industrial Flow of Crude [Man Xuejie, Liu Guoan; RENMIN RIBAO OVERSEAS EDITION, 25 Jun 94]	68
Natural Gas Potential in Chishui Area, Guizhou [Li Bozhong, Yang Chuansong, et al.; TIANRANQI GONGYE [NATURAL GAS INDUSTRY] Vol 14 No 3, 25 May 94]	69
Prospecting Approaches	75

## Science and Technology Policy

### Fresh Call for Piracy Crackdown

40100002A Beijing CHINA DAILY in English 5 Sep 94 p 3

[CD News article]

[FBIS Transcribed Text] The first national work conference convened by the State Council on intellectual property rights has called on 17 ministries to launch an inspection to curb rampant plagiarism and piracy. The move will zero in on property rights for audio and video products, computer software, publications, trademarks, patents and the ban on unethical competition, according to yesterday's People's Daily.

The drive was announced on Friday by the work conference on intellectual property. The conference ordered local governments to wage severe crackdowns on compact disk piracy as soon as possible. Local administrations should immediately investigate the production and sales of each CD assembly line and clear out illegal ones. The conference demanded that this should turn into a regular check-up. It also ordered a manhunt for producers and wholesalers of illicit publications.

While stamping out intellectual infringements, the conference asked local governments to select pilot enterprises to complete an intellectual property protection system which complies with international practices. At the conference, State Councillor Song Jian called for adequate attention to intellectual property issues. He also said China needs one or two more years to finish weaving a complete legal network protecting intellectual rights. He told the conference that the State Council is drafting a regulation on property rights that will cover audio and video products, integrated circuits and botanic species. The council, China's cabinet, is also drawing up an Intellectual Property Border Protection Regulation. A document outlining law enforcement of violations is also expected to come out soon.

In mid-July, the State Council decided to hold regular meetings to discuss the intellectual rights. The work conference is responsible for policies and control of the nation's actions against encroachments.

The Legal Daily said that from 1986 to 1993, courts across the country have agreed to hear 3,505 cases. And several provinces and municipalities like Beijing and Shanghai have established intellectual property courts.

The National People's Congress has also enacted three related laws since 1982: the Trademark Law, the Patent Law and the Copyright Law. By the end of 1993, Chinese enterprises and individuals have also registered 410,000 trademarks and 17,200 patents.

### Pirated CDs Banned But Not Eradicated

95P60005A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 16 Sep 94 p 6

[Article by Zhang Wentian [1728 2429 1131]: "Pirated CDs Banned But Not Eradicated"]

[FBIS Summary] In April and May this year, authorities nationwide began to carry out searches for and confiscations of pirated compact disks (CDs). On the TV screen, viewers could see scenes of audio and video CDs being gathered up and burned in piles, indicating the national government's resolve to protect intellectual property rights [IPR], but simultaneously reflecting the rampant activity in sales of pirated CDs.

Here in Kunming, this writer can see a dozen-odd shops and street stalls selling illegal CDs, with no legitimate CDs in sight. The scene is very animated, with the shopkeepers holding a major "fire sale": only 10 yuan per CD. Buyers are leaping at the opportunity. The owner of one of the shops says he is just shunting the confiscations aside, the implication being that he will continue his business later.

The situation in Beijing is somewhat better, especially after the "strict search and confiscation." Pirated CDs have disappeared from the display shelves, but the word is that this trade has gone "underground." A few days ago in front of the State Trade Center, one could see a pirated-disks free market springing up around dusk. Sellers were clutching large travel bags stuffed with all kinds of pirated CDs: popular to serious music, from the mainland, Hong Kong, Taiwan, and abroad, all sold for 15 yuan per disk. What was surprising was the large number of foreign buyers taking part in this activity. This writer asked one of these foreigners, choosing a CD, if he knew that the disks were pirated. He nodded his head. This writer then asked him why he didn't go to a shop offering legitimate goods, whereupon he answered, "they're too expensive!"

This is exactly the case. Over the past year or so, prices of imported CDs have risen over and over again. CDs exported by the EMI Company have jumped from 90 yuan to 168 yuan apiece, while Delarc's CDs have leapt from 100 to 198 yuan: half a month's wages for the average office worker!

Part of the problem stems from the fact that managers all over the nation have blindly imported CD production lines, with the result that current production capacity far exceeds market demand. Because manufacturers cannot make a profit with legitimate new CDs, they have been forced to turn to "low-cost" production: pirated CDs. In Guangdong, Hainan, and other places, pirated disks go for only a few yuan apiece. While the quality of these CDs is not guaranteed, their price—one-tenth or less that of imported goods—makes them extremely competitive and attractive.

In an interview at the China National Publications Import and Export Corporation's Audiovisual Department, Director Ma told this writer of the grievance he nursed: "In the past, the tariff on imported popular music products was 100 percent, while that for serious music was only 20 percent; now they are the same. In the past, use of foreign exchange was regulated by the state price list, something no longer possible now." After the

recent price increases, he added, sales volume has noticeably dropped, making it even harder to restock. Assistant Director Zhu Yuchun, looking extremely worried, told this writer that pirated CDs are now running rampant, with prices averaging only one-tenth those of imported goods; this makes it extremely difficult to counter the illicit trade. She added that if tariffs could be lowered to 10 percent or less, then the legitimate goods could become competitive; because, in the end, most music lovers still prefer the original copies (if the prices are right!). Heavy traffic in pirated disks causes harm to China's international reputation, she noted.

### Special Report China: Direct Foreign Investments Support China's Economic Development Zones

40101011 Tokyo JOURNAL OF ELECTRONIC ENGINEERING [JEE] in English Vol 31 No 7, Jul 94 pp 82-89

[FBIS Transcribed Excerpts] Because of the growth China now exhibits, many analysts believe this nation will become the world's fourth economic power in the future. Direct foreign investments in China soared in 1992, then escalated 2.3-fold in 1993. While rising direct foreign investments cause currency inflation, and the resulting imports cause drops in China's foreign currency holdings, these investments undoubtedly also serve as a powerful driving force for the Chinese economy. Meanwhile, yen appreciation prompts growing numbers of Japanese enterprises to shift to production in China.

As Japanese manufacturers continue their shifts to bases abroad, Japan's investments in China are growing rapidly. The Electronic Device Research and Statistics Committee of the Electronic Industries Association of Japan (EIAJ) has published a report to describe the growth in China, and Japan's participation in that growth. The report, entitled "Trends in Electronic Industries in China's Economic Development Zones," stems from the EIAJ's on-the-spot surveys.

China's economic reforms began when the nation opened its economy to foreign investments in 1978. These policies received additional support from the 1979 formulation of the Chinese-Foreign Joint Venture Law.

### Diverse Industry Participation

Japan's investments in China largely centered on the electronic industries, light industries such as the manufacture of sewn goods, and materials-producing industries such as cement manufacturing. The Japanese companies participating in these industries counted on low-cost labor in China.

Since the government started permitting foreign companies to operate wholly owned businesses in China, many Japanese electronics companies have made investments in China. Analysts expect growth in the direct investments by Japan's automobile and related industries, power, communication and other large-scale industries.

Recently, the Asahi Bank and the Japan-China Investment Promotion Organization surveyed Japanese businesses about their attitudes toward business in China. About 30 percent of the respondents say they would like to do business in Shanghai, while 21 percent were interested in Shenzhen, and 19% selected Dalian. These three areas represent 70% of the choices respondents made when pinpointing potential investment sites in China. In describing their reasons for selecting specific sites, the respondents say that Shanghai, Shenzhen and Dalian already encourage investments from foreign companies. Furthermore, the respondents say, many Japanese companies already operate in these cities, which offer ample supplies of labor and materials.

Respondents did cite some problems with setting up bases in China. For example, there are difficulties in obtaining production materials in China. Prices are rising and overhead costs are excessive. Other problems affect transportation, production, and quality control.

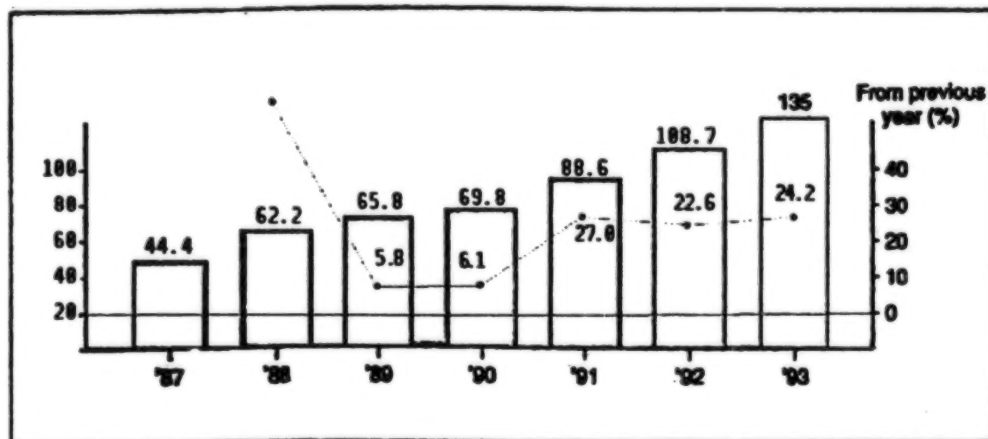


Figure 1. China's Electronics Production. Source: Figures from EIAJ's research mission, using the China Electronics Industries Yearbook



### Business Trends in China's Electronic Industries

In 1992, production from China's electronics industries totaled about 108.68 billion yuan (about ¥1.4 trillion, using an exchange rate of ¥13 to 1 yuan). Since then, the industry has continued to grow.

### Annual Growth Rates

China's electronic industries have maintained growth rates of 20 percent or more since 1991. By 1993, the industry had reached 135 billion yuan. Because of the rapidly growing demand for consumer electronics, computers, communications and other electronic equipment, analysts expect the production totals to surpass 200 billion yuan by 1995.

In the breakdown by use, 50 percent of the nation's electronic production in 1992 involved consumer and broadcast equipment. The categories of standard parts, electronic devices, and computer-related products each accounted for 10 percent.

That same year, China's exports of electronics represented an aggregate total of \$6.87 billion, climbing 31.6 percent from the previous year. This also represented 8.5 percent of the nation's total exports. Simultaneously, imports of electronic goods amounted to \$7.99 billion, a 39.5 percent jump from the previous year.

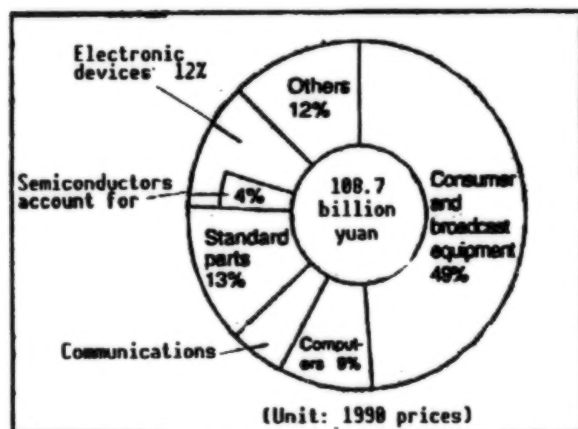


Figure 2. Production Composition for China's Electronics Industries in 1992. Source: Figures from EIAJ's research mission, using the China Electronics Industries Yearbook

### Computers and Communications

Within the field of electronic products, the Chinese government pays particular attention to the production of personal computers, and communication equipment. Demand for personal computers reached 260,000 units in 1992. About 150,000 computers actually reached the marketplace, either through legal routes or through smuggling. Estimates in Chinese newspapers say that the

demand for personal computers totaled 350,000 units in 1993, and will reach 1 million units in 1995.

Several manufacturers already import products for sale in China. The companies in this category include IBM, Compaq and AST. Furthermore, IBM is starting a project to produce personal computers in China. Among the companies considering ways to set up manufacturing operations in China are Unisys, Digital Equipment Corp. (DEC), and Apple.

Similar growth patterns are apparent in the field of communications. Household incomes are on the rise in urban and suburban areas, a situation that helped push telephone subscriptions to 26 million units in 1993. While the saturation rate remains low, the Chinese government is encouraging technical cooperation and joint ventures with foreign companies to stimulate construction of communication infrastructures. According to medium-range views, China's demand for personal computers will grow to 2.5 million units in the year 2000. Simultaneously, subscriber demand for telephones will reach 73.5 million units.

### Issues for China's Electronic Industries

On their way to additional growth, the electronic industries in China will have to solve a number of issues. For instance, it is necessary to improve the management of state-run enterprises. Also, China must adapt to a market economy. The nation must cultivate its local industries for parts and materials as well.

Improving the management of state-run businesses requires another look at several conditions. The production capacity at most state-run enterprises is twice as large as the actual shipments. In other words, these businesses are operating at only 50 percent capacity. Most also suffer from excessive equipment investments.

Furthermore, before China can adapt to a market economy, its electronic enterprises must replace their "production-first" principles with goals more in keeping with market needs. Meanwhile, when cultivating local parts and materials industries, China must find ways to assure that local manufacturers can offer parts and materials of appropriate quality.

Among the Japanese companies with direct investments in China are members of the EIAJ (Fig. 3). Some aim to supply the products they make in China directly to the large Chinese market. Others intend to use China's ample, low-cost labor resources in developing production and supply bases for the global market.

Most of the investments before 1992 concentrated in the northern central coast areas near Beijing and Shanghai. Since then, foreign investors have focused on the Zhujiang delta areas in Guangdong Province, including Shenzhen and Zhuhai.

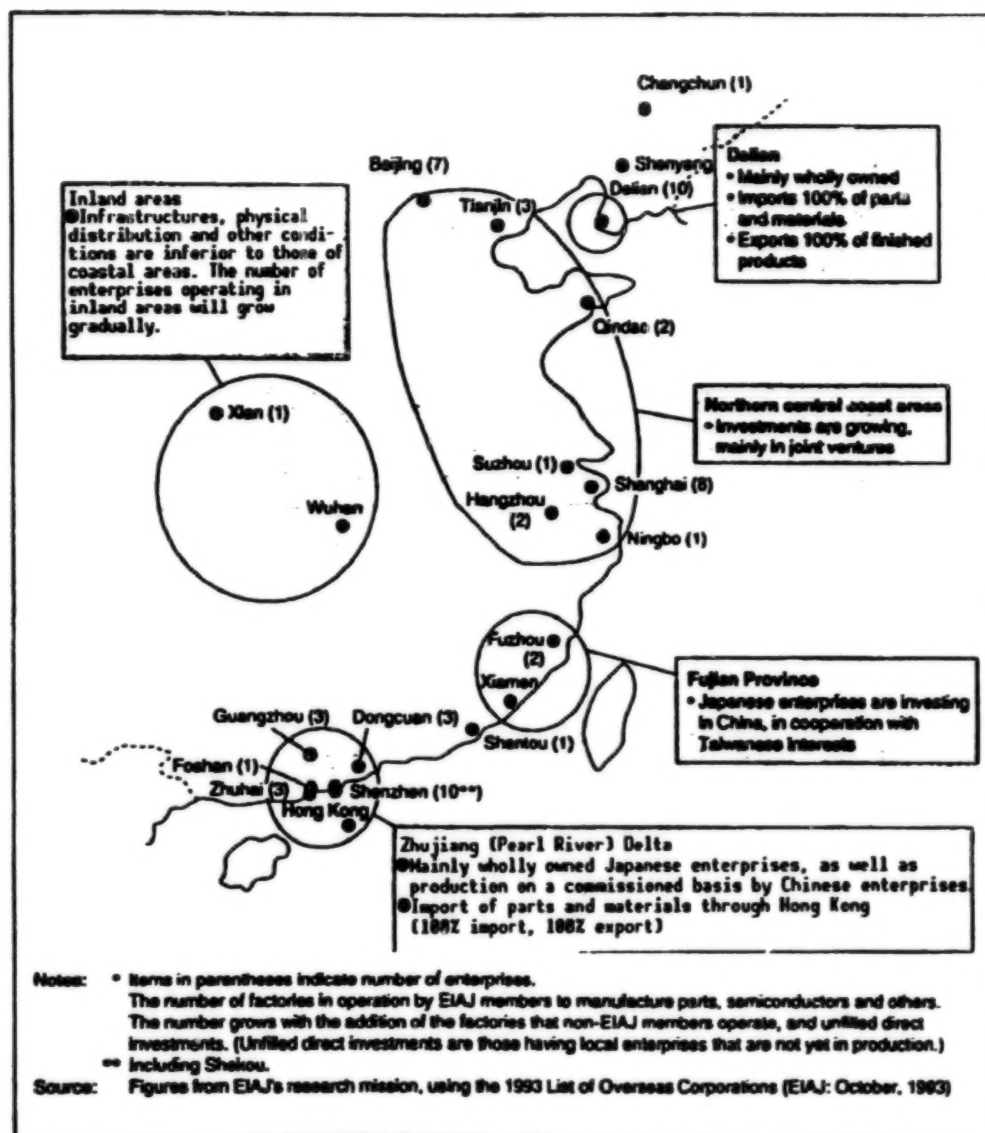


Figure 3. Direct Investments in China Among EIAJ Members

Table 3. Trends in the Scale of China's Semiconductor Market

Level	1991	1992	1993	1994	1995	Annual average growth rate for 1991 to 1995
Yuan basis (100 million yuan)	63	79	99	123	151	24.4
	From previous year (%)	—	25.4	25.3	24.2	22.8
Yuan basis (100 million)	819	1,027	1,287	1,599	1,963	—
	¥ to yuan exchange rate	13	13	13	13	13

Source: Estimate from the EIAJ's research mission.

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### Semiconductor Market in China

The EIAJ's research mission estimates that China's semiconductor market grew to 7.9 billion yuan in 1992 (¥102.7 billion). The team predicts that this market will grow to 15.1 billion yuan (¥196.3 billion) by 1995.

In 1992, China's state-run semiconductor enterprises reported IC production of 620 million yuan. Output of discrete devices totaled 4.36 billion yuan (about ¥56.7 billion). Combined, these two segments of the industry attained an output of 4.98 billion yuan (¥64.8 billion). However, because of the strong demand for semiconductors within China, the nation had to depend on imports.

### State Cultivates Semiconductor Projects

These circumstances have prompted the Chinese government to regard semiconductors as a strategic industry for development. Authorities plan to raise IC production capacities to about 800 million units, attaining a value

scale of about 5 billion yuan. Within the sector for discrete semiconductors, China intends to push transistor output to 10 million units by 1995. By then, optical device production will reach 1.5 billion units, and output of sensors and other units will total 1 billion units. To reach these production goals, China will have to introduce foreign technologies, an activity requiring technical cooperation projects with foreign enterprises. All of these goals are part of the existing five-year plan, which started in 1991.

China's semiconductor industry began to develop in 1956 when the government under the late Premier Zhou En-Lai chose semiconductors as one of six key development issues in science and technology. Early in the 1960s, China began mass-producing transistors and diodes, moving to IC production by the end of that decade. LSI production began in the middle of the 1970s. However, development in the semiconductor industry came to a halt with the Cultural Revolution.

Table 4. Projections for China's Semiconductor Production

	Product classifications	1991	1992	1993	1994	1995	2000
Production volumes	Total for discrete semiconductors	5,060	5,710	6,280	6,910	7,600	10,660
	Total for ICs	120	140	170	250	350	1,100
(million units/year)	Grand total for semiconductors	5,180	5,850	6,450	7,160	7,950	11,760
Production values	Total for discrete semiconductors	5,200	4,310	4,530	4,750	4,990	5,790
	Total for ICs	520	620	780	1,170	1,760	5,370
(million yuan/year)	Grand total for semiconductors	5,720	4,930	5,310	5,920	6,750	11,160
Growth rates for production volumes	Total for discrete semiconductors	63	13	10	10	10	7
	Total for ICs	32	17	20	47	40	25
(%/year)	Grand total for semiconductors	62	13	10	11	11	8
Growth rates for production values	Total for discrete semiconductors	41	-13	5	5	5	3
	Total for ICs	-12	20	25	50	50	25
(%/year)	Grand total for semiconductors	27	-24	8	11	14	11

Note: Figures after 1994 include production by joint ventures.

Source: Estimates from EIAJ's research mission, using the China Electronics Industries Yearbook.

To compensate for the delays in production, the Chinese government's seventh five-year plan focused on developing the semiconductor industry after 1986. So did the eighth five-year plan, beginning in 1991.

As of 1992, there were 23 state-run IC factories and 310 state-run discrete semiconductor makers in China. The nation also had 338 joint ventures with five foreign enterprises, numerous wholly owned foreign businesses, and 13 semiconductor research institutes. State-run makers of discrete semiconductors employ a total of 130,000 workers including 16,000 engineers. The IC manufacturers account for 21,000 employees, including 4,300 engineers.

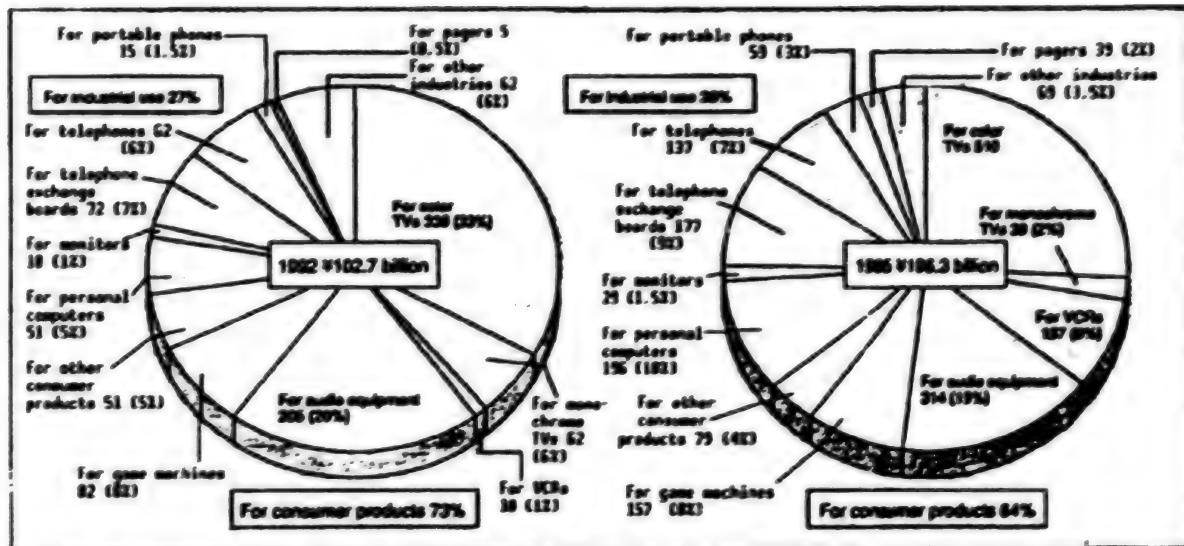
By 1993, most state-run factories used 2 to 5  $\mu$ m processes and turned out 3- to 5-inch wafers. With the

cooperation of foreign manufacturers, the Chinese companies expect to be able to make submicron-level LSIs after 1995.

### Eighth Five-Year Plan

Under the eighth five-year plan now in effect, the Chinese government is striving to establish microelectronics technologies and mass production systems for LSIs. These efforts revolve around five state-run semiconductor enterprises including China Huajing Electron Group Co., Huayue Microelectronics Co., Ltd., Shanghai Beiling Microelectronics Manufacturing Co., Ltd., Shanghai Philips Semiconductor Co., Ltd., and Shougang-NEC Electronics Co., Ltd. The five-year plan encourages investments in LSI production and in activities to manufacture new kinds of electronic devices and power electronics.

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Source: Estimates by EIA's research mission

Figure 4. Trends in China's Semiconductor Market by Use Classification, 1992 to 1995

Other areas of attention encompass optical electronic devices, piezoelectric devices, and sensors.

EIA's research mission estimates that China's semiconductor market accounted for 7.9 billion yuan in 1992 and 9.9 billion yuan in 1993. The analysts also predict that this market will grow to 15.1 billion yuan by 1995. Although the market scale remains small, observers believe the growth rate will be steep, because China is becoming a leading global production base for electronic products and equipment.

Most of the semiconductors that China produces work in TVs, audio equipment, and other consumer electronic products. Such semiconductors accounted for 73 percent of the nation's semiconductor market in 1992. Demand for semiconductor products for communications equipment, personal computers and terminals continues to grow. Analysts estimate the semiconductor market segment for communications and computer equipment accounts for ¥ 70.6 billion, about 36 percent of the total semiconductor market. After 1994, analysts anticipate swelling demand for VCR-use semiconductors. This segment could account for 8 percent of the total market, representing about ¥ 15.7 billion.

In its industrial policies for the future, China intends to improve its self-sufficiency in the semiconductor field. Specifically, the nation intends to assure that local supplies meet 50 percent or more of the demand for ICs serving information, communications and power equipment, and VCRs.

#### Measures to Promote Development of China's High-Tech Industries

946B0099A Beijing JINGJI RIBAO [ECONOMIC DAILY] in Chinese 3 May 94 p 5

[Article by Sui Yinghui [7131 2503 6540]: "Promoting the Development of High-Technology Industries"]

[FBIS Translated Text] Reform and opening to the outside have made China's high-technology industries develop rapidly in certain fields, so that high-technology industry groups based on high-tech industry campuses and high-tech enterprises have begun to take shape, producing major changes in China's industry structure. But an analysis of the current industry structure makes it clear that these changes are still only partial and limited in scale, and this deficiency represents one of the bottlenecks in the promotion of economic growth under a market economy and in the improvement of industry structure. In general terms, the principal problems and difficulties that are hindering and constraining the development of China's high-technology industries are not confined to inadequate funding and failure to emphasize the focal points: they also include the following factors.

1. Lack of systematic, integrated policy restraint and regulation. Although the cognizant state ministries and commissions have handed down some policies dealing with the development of high-tech industries, policies designed to regulate industry focus primarily on enterprises and scientific research departments rather than on the creation of economic levers. As a consequence, some policies lack the necessary macroscopic regulatory strength.

2. The main body of changes involving in the promotion of high-tech products and industry development are proceeding too slowly. The development of high-tech industries focuses primarily on the promotion of large and medium-size enterprises, and if such enterprises cannot function as production bases for the development of high-tech products, the strength of enterprise S&T investments may be weakened and the full-scale development of high-tech industries may be hindered.

3. Emphasis on importation from abroad while neglecting the conversion of internal research results. The result of this factor is a tendency for the high-technology industries to become homogeneous. Actually, in certain areas China's high-tech development results are the best in the world, but the rate of conversion of these results to products is only about 20 percent. If this situation is not corrected, China's high-tech industry development may be controlled by others, and its industries may become merely sales agents for international enterprises.

4. Insufficient importation of large industrial projects and a lack of macroscopic strategic programs and regulation efforts for large-scale production technology. The development of China's high-tech industries currently is falling into the gap between S&T and the economic system, with a lack of policy restraints that are rooted in strategic production technology objectives and strategic focal points. Therefore, in order to develop high-tech industries, as we foster the market economy, we must further accelerate the reform of the S&T and economic systems and intensify macroscopic regulation. We suggest the following principal measures.

1. Establish an industrial policy system that places restraints on the development of high-tech industries. The new industry regulation system will use policy to create levers influencing industry in order to accelerate the advancement of high technology and to promote the optimum disposition of key investments and resources.

2. Use both the importation of high technology and the conversion of domestic S&T results to achieve an optimum adjustment of industry structure. Some traditional industries and enterprises should be revamped and incorporated into the high-tech industry system, allowing them to sink or swim as their capabilities dictate and making sure not to lose long-term development opportunities through the pursuit of short-term financial or tax benefits. In other traditional industries, the importation of technologies and equipment and integrated process modernization can be used to assure that they have advanced facilities and the ability to earn foreign exchange from exports.

3. Stress the development of competitive technology industries. A group of high-technology products that have market potential and are competitive should be identified for targeted support and for development into an industrial-scale economy.

4. Use the joint efforts of large and medium-size enterprises and high-technology research departments to

develop high-technology industries. In China's industrial structure and research structure, high-tech industries come from two sources: from large and medium-size enterprises, and from institutions of higher education and research bodies. At the moment, these two sources are not complementing each other. Therefore, promoting the integration of enterprises with advanced schools and research bodies is a key factor in developing China's high-technology industries. As a product of system reform, joint-stock cooperative entities should be formed by enterprises, advanced schools and research bodies, and state financial support and loans should be used to establish unified research, industry and commercial enterprises, or, in other words, research companies.

5. Make an effort to attract transnational groups and to establish joint-capital cooperative companies or enterprise groups. China should accord full importance to using transnational corporations as a source of high technology and should invite business cooperation. It should use the importation of large projects and large-scale production technology as a way of acquiring development capabilities for high-technology industries and of accelerating the development of China's high-technology industries.

#### **Beijing University Launches Advanced S&T Personnel Program**

946B0098A Beijing RENMIN RIBAO in Chinese  
9 May 94 p 1

[Article by RENMIN RIBAO reporters Lu Xinming [4151 2450 1337] and Bi Quanzhong [3968 0356 1813]: "Greeting the Splendor of the New Century: Beijing University's Next-Century Personnel Program"]

[FBIS Translated Text] "We have said many times that when the centennial of the founding of the state arrives, our economy may be approaching the level of the advanced countries. One reason that we say this is that during this period, we are fully capable of upgrading education, raising China's S&T level, and training hundreds of millions of capable personnel of all kinds and at all levels." "With a population of a billion, if education is improved, the immensity of our personnel resources will be unparalleled in the world." Deng Xiaoping's sagacious comments on the subject of skilled personnel, made 9 years ago, thoroughly express his foresight and acuity as a proletarian strategist. And today, as the new century approaches, an imposing next-century personnel program has been launched at Beijing University. 1987, Washington. Twenty-six-year-old Chinese exchange student Chen Zhangliang [7115 4545 5328] discovers and describes the capabilities of DNA that regulates the embryonal development of plants, an advance that is hailed as "a milestone in botanical molecular biology." The US Department of Energy and Department of Agriculture offer him sizeable research funding in the hope that he will remain in the United States. But in August, Chen Zhangliang appears at the Yanyuan campus of Beijing University, and not long afterward, Beijing University founds



China's first national-level key laboratory in botanical genetic engineering. In 1993, it also founds the "China Biology City." Again in the United States, Chinese exchange student Zeng Yi [2582 3015], who has completed his doctoral studies at Princeton's Population Research Center, creates a "family status chart" which is suited to Third World Countries and breaks free from the constraints of western scientists' nuclear family model. This achievement wins high praise from the international population studies community and comes to be called the "Zeng Yi method." Many international organizations offer him posts, but Zeng Yi returns to China and becomes deputy director of the Beijing University Population Research Institute. 1993, Japan. Chinese exchange student Liu Zhongfan [0491 1813 5400], studying under the founder of modern optoelectronic chemistry Fujishima Teru, raises optical storage technology to the world's highest level and becomes a staff member of the Japanese National Molecular Science Laboratory, a world leader in its field. In June of the same year, 31-year-old Liu Zhongfan terminates 5 years of association with the institute and returns to China with \$250,000 worth of research equipment. In the late 1980's and early 1990's, from the University of Edinburgh, from Harvard, from the University of Tokyo, from the University of Gottingen, from everywhere in the world, young Chinese academics who were just beginning to reveal their potential and to attract attention in their fields returned to China, all gathering at the same location—Beijing University. At the same time, within China, in Yanyuan's fertile soil, Beijing University itself trained New China's youngest woman professor, Lai Luhua [0171 7627 5478], and a group of China-trained but internationally oriented new academic talents emerged. Venerable Beijing University is adding a group of highly able young professors to its faculty, and they have brought new hopes for a flowering of the university and for China's scientific and cultural progress in the next century.

At the beginning of the century, Cai Yuanpei had the boldness of vision to engage famous teachers, laying the foundations of nearly a century of academic and cultural excellence at Beijing University. Today, as a new century approaches, Beijing University again faces an important moment. An educator has said, "A university is a place of great teachers; when you have great teachers, you have a university." And if you survey the nearly 100 years of Beijing University's history, you find that it has flourished to the greatest extent at the times when a galaxy of talent has gathered there. In 1917, China was in a time of trial, wavering between tradition and modernity. When the eminent educator Cai Yuanpei became the president of Beijing University, his first effort was to strengthen its faculty by recruiting a wide range of the most eminent scholars of the time, including Chen Duxiu, Li Dazhao, Hu Shi, Liu Bannong, Ma Yinchu, Yang Changji, Liu Shipai, Gu Hongming, Zhang Shizhao, Shen Yinmo, Qian Xuantong, Liang Shuming, Lu Xun, and Li Siguang. Their average age was only slightly over 30, but the strength of the faculty commanded the admiration of those with a thirst for learning and drew them to the university. Again in the

1930's, Beijing University hired Tang Yongtong, Ding Wenjiang, Zeng Zhaolun, Zhu Guangqian, and Li Xianlin to teach. It was this gathering of great teachers that caused the steady growth of the university's stature, so that in nearly a generation's time, it became China's acknowledged academic and cultural leader. After the founding of New China, in 1952 the people's government carried out the academic reform of higher education, and Beijing University took this opportunity to add a large group of the country's most eminent scholars to its faculty, including Chen Daisun, Zhou Peiyuan, Feng Youlan, Zhang Dainian, Zhou Yiliang, Yang Zhouhan, Wu Zuxiang, Wang Yao, and Li Funing from Qinghua University, Jian Bozan, Hou Renzhi, Lin Geng, Chu Shenglin, and Zhang Pang from Yanjing University, Wang Li from Zhongshan University, and Hu Jiming from Zhejiang University. And although there is still disagreement in the educational community regarding the academic reform, in objective terms Beijing University's faculty benefited immensely from it, and it thereafter trained a succession of exceptionally able persons; as a result, the university has continued to be ranked among the world's great educational institutions. As the end of the 20th century draws near, China has entered the critical years of reform and opening to the outside. In response to the needs of economic development and scientific progress, Beijing University, whose offerings have always centered on the literary arts, has begun to add new applied sciences, technical sciences, emerging engineering technologies and interface sciences. The number of majors in the liberal arts has increased by more than a third, and some basic disciplines and research organizations have created new fields of study in response to the march of events. All of these developments have made new, intensified demands on the faculty. But in the last few years, Beijing University has also lost some eminent and respected teachers whose learning spanned the east and the west, including Wang Li, Zhu Guangqian, Feng Youlan, Hong Qian, Yang Zhouhan, Wang Yaō, Zhu Dexi, Wang Zhuxiang, Lin Chao, Zhou Peiyuan, Wu Zuxiang, and Jiang Zehan. Beijing University still has a strong faculty. Among its 3000 teaching personnel there are 30 academicians of the CAS, 340 doctoral advisors, and 730 professors. More than 60 percent of the faculty members hold high titles, making the university the country's greatest concentration of persons of the highest ability. But behind this superiority in qualified personnel there lurk some hidden numbers: three-fourths of the master's programs will have to add new mainstay and leadership personnel within the next 10 years; of the faculty holding the highest posts, by the end of 1994, 48 percent will withdraw from the first line, and by the university's centennial in 1998, 80 percent of the faculty will have reached retirement age. Of the current Ph.D. advisors, more than half will no longer be able to work on the first line by the year 2000, and at least 200 new doctoral advisers will have to be added. If a university like Beijing University lacks top-flight academic personnel, it may lose its leading rank in the academic world and become unable to shoulder the heavy burden of advancing China's science, technology, and culture. The university's leadership and some of its senior academics

have become clearly aware that they must train successors and develop leadership personnel. Beijing University has begun efforts to train and foster able personnel for the turn of the century.

Beijing University has begun to make plans for the new century before it arrives. Three generations of intellectuals share a common feeling: their devotion to science, to the fatherland, and to the age. Beijing University considers it a duty to attract and nurture able middle-aged and young people. In just the last 5 years, it has promoted more than 190 middle-aged and young faculty to members to professorships or associate professorships. In 1992 and 1993 alone, it gave extraordinary promotions to 103 persons, including the appointment of 56 professors. Of the 107 newly added doctoral advisors, 8 were born in 1950 or later.

**Continuation of the tradition of inclusiveness, elimination of organizational bias, and promotion of geographic diversity.**

In the last 5 years, more than half the middle-aged and young mainstay faculty members that received extraordinary promotions to professorships or associate professorships were from other schools. It is precisely because the university brings in talent from everywhere that it not only has strengthened its capabilities in certain existing fields, but also has added new disciplines and created new areas of superiority. The wellsprings of learning are inexhaustible.

**Promotion based solely on ability, equal treatment of Ph.D.'s earned in-country and abroad, a painstaking effort to foster and select emerging academic talent within the university and to promote their growth and advancement.**

The excellent environment for scholarship and research has caused many scholars to flower.

**Avoidance of stereotyping and of blind adherence to seniority.**

In 1989, Chen Zhanliang, then 28, was given an extraordinary promotion to the post of professor of biology, making him the youngest professor in recent years. This event evoked an immense response both at Beijing University and everywhere on the country's higher-education front. One publication said, "Not only did it provide a glimpse of dawn to the young intellectuals who have been sealed into the lowest-level positions on account of their age, but it also provided a fulcrum for the thinking of personnel management departments at all levels."

**A policy of giving young teachers a full measure of trust and of laying heavy responsibilities in teaching and research or in academic leadership on the younger generation, so that Beijing University's new face is one of youthful clan.**

A group of young professors have been brought on stage: Chen Zhanliang, 31 years old, as head of the Institute of Life Sciences; Tu Ping [3205 1627], 33 years old, as deputy director of the Population Institute; Min Weifang, 43 years old, as head of the Institute of Higher

Education; Liu Wei [0491 0251], 36 years old, as deputy director of the Institute of Economics; Fang Jing [2455 4552], 38 years old, as assistant chairman of the Department of Mechanics; Yan Chunhua [0917 4783 5478], 32 years old, as head of the State Key Laboratory on Rare Earth Chemistry and Applications.

**Full Utilization of Everyone's Capabilities, and a Striving to Give the Younger Generation Scope to Exercise its Talents, Free from Nagging Worries.**

In 1992 the school announced eight major measures designed to attract mainstay middle-aged and young academics. They included: increasing wages and giving faculty with doctorates from the professorial level down appropriate allowances; in awarding government special allowances, the earmarking of a specific number of awards for young mainstay personnel and the granting of special allowances to young academic pace-setters and persons running major research projects; establishment of a Beijing University young investigators' research fund and a young academics' publication fund; continuation of the policy of including a specified number of persons from outside in the extraordinary promotions to high academic posts; and the raising of special funding (or even loans) outside state capital construction allocations for the construction of a residential building of one- and two-room apartments to be set aside for young academic mainstays who join the university. In 1993, Beijing University established a human resources office, then allocated 1 million yuan to establish the Beijing Next Century Young Talent Fund. Shortly thereafter, a public-spirited group in Beijing provided 1 million yuan for the establishment of the 21st Century Personnel Incentives Fund for young teaching personnel. In March of 1994, the Next Century Academic Mainstay Nurturance Project was formally announced, and more specific and thorough activities were begun. At the same time, a group of older academics exhibited yet another kind of devotion to science. When professor of Biology Pan Naisui [3382 0035 3606] was in the United States for advanced studies, he met Chen Zhanliang. He wrote many letters to Beijing University recommending Chen for a position and urged Chen to go to the university when he returned to China. When Wen Lan [2429 5695] of the mathematics department engaged in research on differential dynamical systems under the eminent mathematician Liao Shanchou [1394 1472 3447], he made so many breakthroughs that Professor Liao, recognizing that he had been surpassed by his pupil, stepped down. When Min Weifang returned from abroad and joined the Beijing University Institute of Higher Education, institute head Wang Yongquan [3076 3057 6898] made a point of taking him to a variety of meetings, recommended him for posts in certain academic organizations, and built up his prestige; ultimately, Wang Yongquan resigned his post in Min Weifang's favor. Similarly, at the Population Institute, Professor Zhang Chengyuan [1728 6134 0337] handed over his post to one of the younger generation. Chen Lai [7115 0171] still cannot forget the scene of Professor Feng Youlan's death. At the age of 93, Feng mustered his remaining strength to say to his pupils, gathered around his deathbed, "Chinese philosophy must become glorious." Abundant scholarship, brilliant wisdom, noble character and personal



integrity, and limitless love of science and of the fatherland constituted the spiritual values of the older generation of scholars, and these values have imperceptibly penetrated into the souls of generation after generation of the students at Yanyuan. There are three generations of intellectuals at Beijing University today: the first is the older generation, which was born early in the century, which has mastered both Chinese and western learning and has had distinguished achievements, but is now advanced in years; the second consists of the intellectuals who were trained before the Cultural Revolution and who for several decades have shouldered the heavy task of scientific research, but who will be of retirement age by the end of the century; and the third is today's group of young scholars. Their childhood came at the end of the years of turbulence, and they had a brush with the suffering of the Cultural Revolution, but it also added to their life experience and tempered their will and character, and they subsequently encountered the favorable conditions of reform and opening to the outside. Their time has created an excellent environment for them, such as earlier generations of academics could not have imagined, but has also imposed heavy, unshirkable responsibilities for the start of the new century on their shoulders.

Among the brilliant galaxy of academics at Beijing University, a youthful community has taken shape, which both inherits its elders' profundity and breath and has the fresh mettle and elan of youth, and which is using its youthful vigor to achieve glorious accomplishments, so that in many fields China is among the world's leaders. Paris, 28 October 1991, at UNESCO headquarters. A solemn awards ceremony. As the Jallud Hosein young scientist award, which has been referred to as the "Nobel Prize of youth," is handed to young Chinese scientist Chen Zhangliang, a foreign academic who is present blurts out, "For a Chinese to receive this prize is absurd." Without losing his composure, young Chen Zhangliang replies, "Why shouldn't a Chinese receive it?" In such developments as: young Lai Luhua's research in protein structure prediction and molecular design, which penetrates deep into biological processes and which has been advancing rapidly; the work of 32-year-old urban environment professor Yang Kaizhong and his colleagues, who have successfully run the first international regional scientific conference for the developing countries, winning the admiration of member of the US National Academy of Sciences Woerde Aisade [phonetic], the father of world regional science; the naming of the Beijing University Population Institute, where Zeng Yi works, as a World Health Organization cooperative research center for reproductive health and population science (the first in China, and one of very few anywhere); and the appointment of Min Weifang of the Higher Education Institute as one of the expert group of the World Bank's education project for the poor provinces of China and his assignment as a World Bank higher education investment advisor for Eastern Europe and South Asia, the first Chinese to hold this post, we can see that unlike the previous two generations of intellectuals, this generation has been able to attain the heights of world scientific, technological and cultural development, and thus has a

broad professional world view and a vigorous creative spirit. In addition, since this generation established itself under China's particular conditions, it is able to acutely grasp the newest dynamics of international specialist developments and to make immediate use of the most advanced scientific research techniques to orient China toward the world and to enrich the world's cultural treasures. Beijing University's department of mathematics has done work of world caliber in many mainstream areas of mathematics and its applications. Among its young academics, Zhang Jiping [1728 4949 1627], who studied finite group representation models, an important central topic of mathematical theory, has obtained numerous results and has created a stir in the international group theory community. Wang Shicheng [3769 6108 2052] has won worldwide recognition for his accomplishments in low-dimension topology, and the 1990 comprehensive report of an international mathematics conference specially mentioned one of his contributions. Wen Lan has won acclaim for his researches in dynamical systems, and Peng Lizhong [1756 4539 0022] has been hailed as a leading international expert in affine transforms. Liu Zhongfan of the chemistry department has maintained top standing in the field of intelligent materials. The work of Zhao Xinsheng [6392 2450 3932] in laser chemistry, that of Yan Chunhua in the chemistry and applications of rare-earth materials, and that of Zhou Qifeng [0719 0366 7685] in liquid-crystal macromolecular substituent effects, is at the world state of the art. At the computer institute, Xiao Jianguo's [5135 1696 0948] research on a newspaper composition system resulted in the world's first large-screen full-page Chinese-language composition system, which is of major world importance. Zheng Min's [6774 3046] research produced a new-generation multiwindow integrated composition system that has been hailed as bringing about a new revolution in China's printing industry. In the department of English, 33-year-old Professor Shen Dan [3947 0030] has made advances in literary genre theory and has challenged the ideas of US literary-theory circles and international translation circles; according to renowned authority Xilisi Miluo [phonetic], "he has remarkable abilities and uncommon perceptiveness" and "is an extremely remarkable teacher, scholar, and critic." The History Department is one of the three pillars of Beijing University's humanities division. Thirty-four-year-old Professor Rong Xinjiang [2837 2450 3068] has achieved world leadership in the area of Dunhuang studies, which has been called the "history of China's sorrows." In this field of medieval history, by the beginning of the next century Beijing University has the potential to produce more than 10 world-class scholars. In world history, nine young scholars, including Gao Yi [7559 3015] and Zhu Xiaoyuan [2612 1321 6678], have broken free of the excessive concentration on political struggle that constrained the older history and are engaged in rewriting the book "Shijie Tongshi" [World History]. They are referred to as the history department's "young guard." In the Philosophy Department, Professor Chen Lai's [7115 0171] unparalleled studies of the writings of the philosopher Zhu Xi have been described as epoch-making and as a model for mainland Chinese

philosophical research. He accepted an invitation to give English-language lectures in Song and Ming philosophy at Harvard and Columbia universities, which were enthusiastically received. The maturing of Beijing University's new-century personnel is no longer simply a matter of filling the successor gap at the turn of the century: it has come to represent an emergence from the wilderness of the 20th century by Chinese science and culture and a new gathering together of the main currents of world scientific and cultural development. As a result of its efforts, eastern and western culture are giving off brilliant rays at the turn of the century.

Shortages of housing, funding, and a variety of microstructure aspects form inescapable chains that hinder the next-century personnel program. But this is just a beginning. While the maturing of the young scholars at Beijing University is an inspiring sight, this next-century personnel program is having difficulty getting off the ground. In the spring of 1994, I paid a visit to President of Beijing University Wu Shuqing [0702 2885 7230]. When I asked him to name the greatest problems facing the nurturing of personnel for the new century, he answered, "Housing and funding." In the next few days of my visit, I put the same question to more than 20 university officials and young and middle-aged scholars; the answer was always the same: "Housing and funding." Beijing University now has nearly 7000 faculty members and employees, office space is very scarce, and some teachers must use their living quarters as their offices—but we all know that living quarters too are scarce in institutions of higher education, and the shortage is especially great at Beijing University. In the last half-year, Beijing University's personnel office has received many applications from able young academics who could not be hired because of the housing shortage. In the last 3 years, the university has built several hundred residences, but it is still unable to alleviate the faculty housing problem. The housing problem has been described by university officials as an "inescapable chain." With an annual budget of only 60 million yuan, the university is powerless to deal with the problem, and in addition, talented young faculty members are urgently in need of startup funding. This threadbare condition has been a major hindrance to the implementation of the university's next-century personnel program. The key to overcoming these obstacles involves a variety of system reforms, together with a change in thinking. By the beginning of the next century, Beijing University will need to train at least 150 additional academic leaders. Ninety percent of the doctoral advisers at China's advanced schools are also urgently in need of successors. Various fields throughout the country are suffering from the personnel gap to various degrees. The Beijing next-century personnel program, which is now in the ascendant, has already given us inspiration and hope, but smoothing the road to the nurturance of personnel for the new century and finding superior personnel resources have become an urgent task for the country and its people. "In the areas of education and manpower, we need farsighted strategic vision." These

perceptive words of Comrade Deng Xiaoping, the main architect of reform and opening to the outside, again resound in our ears.

### State to Build Bases for Domestic Production of Major Technological Equipment

946B0099B Beijing ZHONGGUO KEXUE BAO  
[CHINESE SCIENCE NEWS] in Chinese 13 May 94 p 2

[Article by Guo Jing [6753 0079]: "China to Establish Bases for Domestic Production of Major Technological Equipment"]

[FBIS Translated Text] Last year, the national economics and trade conference explicitly stated that enterprises and enterprise groups should be given support in their efforts to establish 20 domestic production bases for major technological equipment: this is an important activity in which the State Economics and Trade Commission (SETC) promotes enterprise reform and technological progress, chiefly via the enterprises. In addition, it is a major activity of the SETC's technology and equipment office. The effort to achieve domestic production of major technological equipment has already been taken on by the SETC; the specific activities will be carried on by its technology and equipment office. A discussion draft version of the document "Provisional Measures for Supporting the Establishment of a Domestic Production Base for Major Technological Facilities by Enterprises or Enterprise Groups" has been prepared and the relevant departments will hold discussions at the major technological equipment conference to be held in May [1994]; after further solicitation of views from all parties and revisions, the document will be formally handed down for trial implementation. For 10 years, the implementation of the State Council Decision on the Vigorous Development of Major Technological Equipment has led to major achievements in the effort to achieve domestic production of this equipment. During the Seventh 5-Year Plan, the development of more than 30 sets of equipment was carried on and such equipment was disseminated and put into use in more than 40 projects; domestic production of sets of equipment was achieved in 10 of these cases, assuring the completion and commissioning of state key engineering projects. During the Eighth 5-Year Plan, 11 special projects and 400 individual topics in key R&D subjects have been set up, and 51 special projects involving major technological equipment and technological modernization have been set up, with coordinated technological modernization and technology importation. Currently, there is some domestic production capability for supplying major technological equipment, and a set of production bases for the domestic manufacture of sets of equipment has begun to take shape. But the scale of production and the design and manufacturing technologies of these production bases do not yet satisfy the needs of China's economic development and they still lag somewhat behind the world state of the art. Thus, they need continued support and encouragement.

## Advanced Materials and Superconductivity

### Further Details on Nanoscale Electrode Inserted into Human Cell

94P60353A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 22 Jul 94 p 1

[Article by Ruan Xianghua [7086 3276 5478]: "Zhang Xueji Fabricates World's Smallest Electrode"; cf. early brief report in JPRS-CST-94-007, 3 May 94 p 8]

[FBIS Summary] Wuhan University Ph.D. candidate Zhang Xueji [1728 1331 6068], in his dissertation project in analytical electrochemistry, has used a plasma etching technique to fabricate the world's smallest electrode—a nanoscale electrode—which he inserted into an active nerve cell to detect dynamic information from a neurotransmitter within the cell. This astounding achievement, described by the five-member dissertation review committee (led by Beijing University Chemistry Department Chairman Prof. Li Nanqiang [2621 0589 1730]) as being on the frontier of life sciences research, will provide a powerful new research tool expanding the recognition limits of the microscopic world.

Zhang's breakthrough represents a new plateau in the "war" initiated by the German scientist Nai-er [Neuer] and other scientists in 1991: whoever was first to successfully invade the realm of the cell by inserting a nanoscale electrode would be the victor. Zhang's cutting-edge achievement follows upon the 1992 U.S. fabrication of a nanoscale electrode by a flame etching technique, but the process was difficult to control and the surface smoothness of that electrode could not reach the molecular level—the electrode tip was still too coarse (60 nm) to be inserted into a [single] cell. Building upon this American achievement, Zhang started out with carbon fiber, which he processed with a plasma-beam sector spin etching technique to fabricate an electrode with a tip diameter of under 30 nm; the process was controllable and surface smoothness of the electrode reached the nanometer level. Moreover, Zhang succeeded in inserting this nanoscale electrode into a suspended single nerve cell and measuring—in the presence of an anti-septic acid—the intracellular content of the neurotransmitter dopamine, as well as other dynamic information.

Zhang's achievement has created quite a little furor in the scientific world: renowned research institutions in five nations of Europe and America—as well as Taiwan's Central Research Institute—have formally invited him to initiate cooperative research projects. Also, several major domestic manufacturers of nutrient solutions [i.e. nutritional supplements] for athletes and sports participants have sought Zhang's assistance in applying techniques of microscopic life sciences to reveal in detail the health- and strength-generating mechanisms of their products.

### Preparation of Amorphous SiO<sub>2</sub>-Ag Nanocomposite via Gamma-Ray irradiation/Sol-Gel Method

94P60381A Beijing KEXUE TONGBAO [CHINESE SCIENCE BULLETIN] in Chinese Vol 39 No 15, 1-15 Aug 94 p 1440

[Letter from Zhu Yingjie [2612 5391 2638], Qian Yitai [6929 6654 3141] et al. of the Applied Chemistry Dept., USTC, Hefei 230026: "Preparation of Amorphous SiO<sub>2</sub>-Ag Nanoscale Composite Material via Gamma-Ray Irradiation/Sol-Gel Method," supported by grant from NSFC; MS receipt date not given]

[FBIS Abstract] The authors have prepared an amorphous SiO<sub>2</sub>-Ag nanoscale composite (nanocomposite) via a combination of gamma-ray irradiation and a sol-gel technique. Analytically pure AgNO<sub>3</sub> is dissolved in distilled water to make a 0.01 mol/L AgNO<sub>3</sub> solution, to which is added 0.01 mol/L dodecyl sodium sulfate as a surface activating agent to stabilize the metallic Ag colloidal solution. Then 2 mol/L isopropyl alcohol is introduced to eliminate the free OH radicals generated by the irradiation process. High-purity nitrogen gas is passed through the solution for 1 h to eliminate dissolved oxygen, then the solution is irradiated in a 2.59 x 10<sup>15</sup> Bq <sup>60</sup>Co source field and given a radiation dose of 8.1 x 10<sup>3</sup> Gy to produce a reddish-brown colloidal Ag solution. Then 5 ml of ethyl ester silicate is dissolved in 10 ml of isopropyl alcohol and 25 ml of water and rapidly mixed in a magnetic mixer; several drops of concentrated HNO<sub>3</sub> are added to keep the pH value around 2. After continuous stirring for 1.5 h, 150 ml of the irradiated colloidal Ag solution is introduced, the solution is stirred, and several drops of concentrated ammonia water are added to raise the pH to 8. Drying produces a brown transparent gel, which is polished and then cleansed several times with ammonia water and distilled water to eliminate impurities. Finally, the gel is dried to produce the amorphous SiO<sub>2</sub>-Ag nanocomposite. TEM reveals that the metallic Ag particle size in the amorphous SiO<sub>2</sub> is in the 4-20 nm range, averaging 7 nm.

Figure 1, not reproduced, shows a TEM micrograph of the nanocomposite. There are no tables.

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### Nation Is First to Find Rectifying Contact Formed by Undoped Solid C60, Semiconductor

94P60377A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 1 Aug 94 p 1

[Article by Bai Zhizheng [4101 1807 2973]: "China Discovers Rectifying Contact Formed by Undoped Solid C-60 and Semiconductor"]

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[FBIS Summary] Scientists from the Physics Department and Chemistry Department of Beijing University in late January 1994 discovered a strong rectification in an undoped C-60/P-type silicon combination. Using an ultrahigh-vacuum system and 99.9-percent-pure C-60 powder they then developed a niobium-doped C-60/P-type silicon rectifying diode, followed by discovery of strong rectification in a C-60/n-type silicon combination, which has a conducting polarity reversed from that of C-60/P-type silicon. In early June, these scientists then developed a titanium-doped C-60/n-type silicon rectifying diode. Most recently, the Beijing University scientists have reported the discovery of a rectifying contact formed by a fixed-thickness undoped solid C-60 film and a semiconductor—the first such report worldwide.

#### **Omnibearing Ion Implanter Unveiled**

94P60377B Beijing ZHONGGUO KEXUE BAO  
[CHINESE SCIENCE NEWS] in Chinese 3 Aug 94 p 1

[Article by Deng Xianchun [6772 6343 2504] and Liu Xiaoge [0491 1420 7245]: "Omnibearing Ion Implanter Unveiled"]

[FBIS Summary] The nation's first large-scale omnibearing ion implanter, developed by the nuclear industry's Southwest Institute of Physics in collaboration with Southwest Jiaotong University and the CAS Shanghai Institute of Metallurgy, passed the technical appraisal conducted by CNNC in Chengdu on 13 July. Developed over a 3-year period (1991-1994) as an 863 Program New Materials Area key project, this ion implanting apparatus has applications in surface processing of metals, semiconductors, polymers, and ceramic materials.

#### **Nation's First Cubic Boron Nitride Production Line Operational**

94P60353B Beijing ZHONGGUO HE GONGYE BAO  
[CHINA NUCLEAR INDUSTRY NEWSPAPER]  
in Chinese 6 Jun 94 p 1

[Article by Shi Yansong [2457 1484 2646] and Lu Yi [4151 5030]: "Nation's First Cubic Boron Nitride Production Line Formally Operational"]

[FBIS Summary] The nation's first cubic boron nitride production line, developed as a State Eighth FYP Key Project and installed at the State-run Feidie [7378 4308] Superhard Materials Machinery General Plant (Plant 233) in Hunan Province, on 19 May passed the acceptance check conducted by the China National Nuclear Corporation (CNNC), and is thus formally operational. Civil construction for this production line, which began on 8 June 1992 and ended on 20 August 1993, was followed by an 8-month equipment installation/debugging/trial operation period before the acceptance check. This production line, which involves 5110 square m of plant area, 135 pieces of equipment, and a gross investment of 11 million yuan, has a designed annual production capacity of 290,000 grams of cubic boron nitride monocrystals and

40,000 compound wafers, amounting to newly added value of over 9 million yuan and State taxes of 3.47 million yuan. A portion of the output will be for export; planned annual export volume is US\$300,000.

#### **Biotechnology**

##### ***In Vitro* Cultivation of the Exoerythrocytic Stage of Plasmodium Vivax (Southern China Isolate)**

40091011A Shanghai ZHONGGUO  
JISHENGCHONGXUE YU JISHENG-CHONGBING  
ZAZHI [CHINESE JOURNAL OF PARASITOLOGY  
& PARASITIC DISEASES] in Chinese Vol 12 No 2,  
May 94 pp 83-84

[Article by Luo Shuhong [5012 2885 1347], Liu Duo [0491 1122], et al. of the Hunan Medical University, Changsha]

[FBIS Abstract] An *in vitro* culture system for the exoerythrocytic (EE) stage of *Plasmodium vivax* was first developed in this laboratory in China. *Anopheles stephensi* mosquitoes were infected by membrane feeding with heparinized blood from a volunteer. After 14-18 days, the mosquito salivary glands were aseptically dissected in culture medium and ground in a tissue grinder to form sporozoite suspension. Sporozoites were counted and added to the cultures of monolayer hepatoma cells at the number of  $4.9 \times 10^4$ - $1.3 \times 10^5$  per cover glass. Sometimes, 8-10 pairs of infected glands were added directly to the cultured cells. On day 7, EE schizonts of *P. vivax* were found in cultures. In addition, normal erythrocytes (type O) were added to the cultures on day 10 at a concentration of  $10^8$  per dish. Fourteen days later, erythrocytes in culture supernatant were collected and thin blood films were made. Numerous intra-erythrocytic *P. vivax* parasites were identified on the films after Giemsa staining. Most intra-erythrocytic forms were rings and early large trophozoites. Schuffer's dots were present in many of the infected cells which were pale and obviously enlarged. These results indicated that the *in vitro* hepatic cycle of *P. vivax* was established.

This project was supported by the National Natural Science Foundation.

##### **DNA Sequencing of Circumsporozoite Protein Genes of Plasmodium Vivax From Four Different Countries in West Pacific Region: Comparative Study on the Flank Sequences**

40091011B Shanghai ZHONGGUO  
JISHENGCHONGXUE YU JISHENG-CHONGBING  
ZAZHI [CHINESE JOURNAL OF PARASITOLOGY  
& PARASITIC DISEASES] in Chinese Vol 12 No 2,  
May 94 p 92

[Article by Huang Tianyi [7806 1131 6146] of the Guizhou Provincial Institute of Parasitic Diseases, Guiyang, Cheng Qin [4453 0530] and Allan Saul of the Queensland Institute of Medical Research, Brisbane, Australia and et al.; This research work was supported by UNDP/World Bank/

WHO Special Programme for Research and Training in Tropical Diseases (ID:900147).]

[FBIS Abstract] *P. vivax* CSP gene of 18 isolates from infected blood of patients living in China, Philippines, Solomon Islands and Papua New Guinea in West Pacific region has been sequenced from both terminal end. The total readable sequence in most isolates was about 725 base pair (bp), including the first two repeat units (70-330 bp) to the N terminus, and the last two repeat units to the C terminus (763-1,228 bp).

Comparison and analysis of these obtained sequences with the published sequences of N.K., Thai., Belem, Sal-I. and BZL strains showed that: the N and C terminus sequences flanking the center repeats in CSP gene were highly conserved in all isolates and identical with the 5 published sequences but a double base pair substitution in each end and a remarkable polymorphism in the postrepeat variable region in C terminus were found, including some diversities with obvious geographic characteristics which have not been reported previously.

#### Analysis of the Target Epitopes Recognized by Two Monoclonal Antibodies Directed to Egg-Associated Fractions of *Schistosoma Japonicum*

40091011C Shanghai ZHONGGUO  
JISHENGCHONGXUE YU JISHENG-CHONGBING  
ZAZHI [CHINESE JOURNAL OF PARASITOLOGY  
& PARASITIC DISEASES] in Chinese Vol 12 No 2,  
May 94 pp 98-99

[Article by Qian Zongli [6929 1350 4539] and Lu Ping [7120 1627] of the Department of Parasitology, Shanghai Second Medical University, Shanghai, Qian Rong [6929 1539] of the Shanghai Institute of Biochemistry, Academia Sinica, Shanghai and Deelder AM of the Laboratory for Parasitology, University of Leiden, The Netherlands]

[FBIS Abstract] Two IgM isotype monoclonal antibodies (McAb), 2H10 and 2H1, recognizing repetitive epitopes on *Schistosoma* egg-associated molecules were characterized and their specificities were identified in a two-site sandwich ELISA system. In consistent with the differences in immunological behaviour and specificity demonstrated with immunoelectrophoresis (IEP) and immunofluorescent antibody (IFA) techniques, absolutely negative reactions found in the heterologous detecting system with alternated capture and detecting McAbs of the two revealed a complete incompatibility giving evidences that epitopes on different molecules were recognized. Immunological liability of the target antigen SEA or SEA-TCA to the two McAbs were demonstrated on sodium periodate and trifluoroacetic acid treatment indicating the biochemical nature of these epitopes were glycosylated molecules with apparently higher resistance to the oxidizing agent showing in 2H10 recognizing epitopes.

By means of an ion-gradient Mono-Q FPLC system (Pharmacia), 2H10-reactive epitopes of SEA, being tested not so efficiently adsorbed by ConA-sepharose affinity column,

was found successfully concentrated in the profile eluted with pH 8.0 PBS at 0.2-0.4 NaCl ionic strength. Repeated trials on SDS-PAGE and Western blotting analysis with the reactive fractions further showed a heterogeneity of molecular weight range as well as the non-transferable property of the CHO-reactive groups.

#### Construction of a cDNA Library of the Erythrocytic Stage of *Plasmodium Vivax*

40091011D Shanghai ZHONGGUO  
JISHENGCHONGXUE YU JISHENG-CHONGBING  
ZAZHI [CHINESE JOURNAL OF PARASITOLOGY  
& PARASITIC DISEASES] in Chinese Vol 12 No 2,  
May 94 p 106

[Article by Qiu Chiping [6726 2170 1627] and Tong Xiaomei [4547 1420 1188] of the Institute of Parasitic Diseases, Chinese Academy of Preventive Medicine, Beijing, Project supported by TDR Director's Initiative Funds. WHO Collaborating Centre for Malaria, Schistosomiasis and Filariasis.]

[FBIS Abstract] *Plasmodium vivax*-infected blood samples were collected from patients in the field during malaria transmission season. Total RNA of the parasites was extracted by guanidine HCl/cesium chloride centrifugation. mRNA was purified through oligo-dT cellulose. Double stranded cDNA were synthesized with AMV reverse transcriptase by Huynh's method. gt11 phage was used as the vector. A cDNA library of the erythrocytic stage *P. vivax* was constructed after recombination of DNA and package in vitro.

#### Detection of Specific DNA Fragment of *Plasmodium Falciparum* by Solid Phase PCR

40091011E Shanghai ZHONGGUO  
JISHENGCHONGXUE YU JISHENG-CHONGBING  
ZAZHI [CHINESE JOURNAL OF PARASITOLOGY &  
PARASITIC DISEASES] in Chinese Vol 12 No 2, May 94  
p 124

[Article by Yu Yang [0060 3152], He Jianwen [0149 1696 2429], et al. of the Department of Clinical Laboratory, Changhai Hospital, Second Military Medical University, Shanghai]

[FBIS Abstract] Solid phase PCR for detecting *Plasmodium falciparum* was established and used to detect cultured FCCI/HN isolate and malaria patients in Yunnan Province. The results revealed that the sensitivity of the method for detecting FCCI/HN isolate DNA was as minimal as 0.2 pg, or about 10 parasites. The specificity of the method was confirmed by discriminating malaria patients infected with different species of *Plasmodium*. The results suggest that solid phase PCR is a specific and sensitive method for early detection of *P. falciparum*.



***In Vitro* Sensitivity of *Plasmodium Falciparum* to Mefloquine, Quinine, Amodiaquine, Chloroquine, Pyronaridine and Sulfadoxine/Pyrimethamine in South Yunnan**

40091011F Shanghai ZHONGGUO JISHENGCHONGXUE YU JISHENG-CHONGBING ZAZHI [CHINESE JOURNAL OF PARASITOLOGY & PARASITIC DISEASES] in Chinese Vol 12 No 2, May 94 p 142

[Article by Yang Henglin [2799 1854 2651], Yang Pin-fang [2799 0756 5364] and Yang Yaming [2799 0068 2494] of the Institute of Malaria Prevention and Treatment of Yunnan Province, Simao; Supported by the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases (900098), and the Scientific Foundation for Youth, Ministry of Public Health, China.]

[FBIS Abstract] The sensitivity of *P. falciparum* to mefloquine, quinine, amodiaquine, chloroquine, pyronaridine, and sulfadoxine/pyrimethamine (MEF, QNN, AMO, CHL, PYR, S/P) was tested using *in vitro* microtest in south Yunnan Province in 1992. The ID<sub>50</sub> were 46, 480, 52, 150, 15 and  $2 \times 10^4/25 \times 10^2$  nmol/L, respectively; ID<sub>95</sub> were 160, 1,536, 292, 680, 60 and  $24 \times 10^5/3 \times 10^5$  nmol/L, respectively. All the isolates (30) were sensitive to MEF and QNN; 100% (30/30) and 96.7% (29/30) isolates were found to be resistant to AMO and CHL, the cross-resistance rate was 100% to the two drugs. One of 5 isolates exhibited resistance to PYR. The results suggest that the *P. falciparum* was susceptible to MEF and QNN, but was resistant to AMO, CHL and S/P. CHL-resistant *P. falciparum* showed a marked cross-resistance to AMO, but not to MEF, QNN, and S/P; AMO-resistant *P. falciparum* exhibited cross-resistance to CHL, but not to MEF, QNN, and S/P.

**Molecular Cloning and Sequencing of an Isolate of Hepatitis Delta Virus from Henan, China**

40091011G Beijing BINGDU XUEBAO [CHINESE JOURNAL OF VIROLOGY] in Chinese Vol 10 No 2, Jun 94 p 107

[Article by Liu Shanlu [0491 0810 1982], Zhan Meiyun [6124 5019 0061], and Tan Wenjie [6223 2429 2638] of the Institute of Virology, Chinese Academy of Preventive Medicine, Beijing]

[FBIS Abstract] A complete nucleotide sequence of an isolate of hepatitis delta virus, which is 1674bp in length, is determined by cloning and sequencing six overlapping cDNA fragments, from a HBsAg carrier positive both for anti-HDAg and HDV RNA from central China, Henan province, using reverse transcription and polymerase chain reaction. Comparison of this Chinese isolate with other known HDV isolates Taiwan (genotype IA), US-1 (genotype IB), Japan-1 (genotype II) and Peru-1 (genotype III) showed 94.3%, 86.8%, 75.4%, and 66.3% homology for nucleotide, and 89.7%, 85.1%, 71.9% and

64.6% homology for amino acid, respectively. Five conserved regions in the nucleotide sequence and two conserved regions in the HDAg amino acid sequence were located, which are crucial for some important functions of hepatitis delta virus. (The sequence has been deposited in GenBak/EMBL at accession no. X77627.)

**cDNA Cloning, Sequencing and Expression in *E. Coli* of the C Region of HCV Genome Derived from Chinese Patient with HCV Infection**

40091011H Beijing BINGDU XUEBAO [CHINESE JOURNAL OF VIROLOGY] in Chinese Vol 10 No 2, Jun 94 pp 116-117

[Article by Yang Yongping [2799 3057 1627], Xia Ning-shao [1115 1337 6730], et al. of the Institute of Virology, Chinese Academy of Preventive Medicine, Beijing]

[FBIS Abstract] A cDNA fragment of C269/831(560bp) and three cDNA fragments of C831, C801, C587 corresponding to the putative nucleocapsid(C) of the HCV genome were obtained from the sera derived from Chinese carriers with HCV infection, who came from Loudi of Hunan province and Qinghuangdao of Hebei province of China, by application of reverse transcription (RT) and polymerase chain reaction (PCR) technique. As the sequence of the cDNA fragment of C269/831 (HCV-Hunan Strain) was determined and compared with those of the corresponding regions of the HCV-I (HCV-US) and HCV-II (HCV-BK) genomes, the nucleotide/amino acid sequence homologies to HCV-US and HCV-BK isolates were found to be 90.3%/94.6% and 95.2%/94.6%, respectively. The prokaryotic expression vector pBV220 was employed for the overproduction of CL, CM and CS native recombinant proteins in *E. coli* cell derived from C831, C801 and C587 cDNA fragments. The expression products were screened by bacterial clony hybridization, antibody-sandwich enzyme immunoassay, and determined by Western blotting with antisera of chronic hepatitis C patients. The 20kD recombinant proteins CL, CM and the 14kD of recombinant protein CS were shown to account for about 11% of the total cellular soluble proteins. The recombinant expression products were extracted from the bacterial lysates by lysozyme, Triton X-100 and urea treatment, and purified through the ion exchange chromatography. The purified recombinant nucleocapsid protein CS was used to capture and measure reactive antibodies for both acute and chronic HCV infections. This study indicates that at the nucleotide level, the C269/831 cDNA sequence homology (95.2%) between the HCV-Hunan isolate and the HCV-BK isolate is higher than the homology (90.3%) between the HCV-Hunan isolate and HCV-US isolate, but at the amino acid level, the sequence homology (94.6%) is similar between the HCV-Hunan isolate and both HCV-BK or HCV-US isolate. In addition, the HCV-Hunan is significantly diverse from other HCV isolates, which proves once more that the HCV genome is heterogeneous among the different isolates derived from different areas. More conservative is the amino acid sequence of the N terminal two hydrophilicities of C region of the HCV genome among the all different

HCV isolates, which suggests that the N terminal two hydrophilicities of C region of the HCV genome would have an important biological function, and would be an appropriate antigen for the HCV serodiagnosis. There is 99% of overlapping immunoreactivity between the total nucleocapsid region and the CS, which is composed of 89 amino acids of the N terminal two hydrophilicities of C region of the HCV genome. As for the expression level and the antigen stability, recombinant protein CS was found better than CL and CM.

#### Development of a New Type HCV EIA Diagnostic Kit

400910111 Beijing BINGDU XUEBAO [CHINESE JOURNAL OF VIROLOGY] in Chinese Vol 10 No 2, Jun 94 p 127

[Article by Yang Yongping [2799 3057 1627], Xia Ning-shao [1115 1337 6730], et al. of the Institute of Virology, Chinese Academy of Preventive Medicine, Beijing]

[FBIS Abstract] Effective antigenic domains of structural C, E1-E2 and nonstructural NS3-NS5 regions throughout the HCV genome, derived from Chinese HCV carriers, were cloned and expressed in *E. coli* cell, and many immunodominant epitope peptides corresponding to these regions were synthesized by a chemically synthetic method. These recombinant and synthetic-derived antigens were then used to capture and measure reactive antibodies circulating in the different individuals. Their antigenicities were studied and were found that nucleocapsid (C), NS3 and NS5 polypeptides contain nearly all immunodominant epitopes, and their antibodies come out early (NS3 and NS5 polypeptide for 6 weeks, C polypeptide for 9 weeks after transfusion), and are specific and broadly reactive. The C33c recombinant protein corresponding to NS3 region of HCV is a better antigen than the others. Purified C33c recombinant protein combined with a branched peptide MAP-C-19 representing immunodominant epitopes on the nucleocapsid region was used to develop a New Type HCV EIA Diagnostic Kit for the detection of anti-HCV antibodies. Its specificity, sensitivity and reproducibility were all in keeping with the indexes of the national reference sera. The conformity rate between our kit and the Abbott/UBI HCV EIA, the 2nd generation diagnostic kit, was 99.3%, and our kit identification rate for positive anti-HCV was (2%) more than those of Abbott and YES kits. We have found that the great diversity of HCV genome in different area would affect the establishment of the diagnostic tools. The positive rate of anti-HCV antibodies among different groups in China, obtained by application of our kit for serodiagnosis, was 1.4% in normal population, 1.2% in volunteer donors, 24% in paid donors, 28.8% in in-patients relative to surgery and 34.4% in hepatitis cases. These results showed that injection, vaccination, acupuncture and surgical instruments play a great role in HCV infection (85% of the total case). (EIA: Enzyme Immuno-Assay.)

#### Typing of HFRS Viruses in China by Polymerase Chain Reaction

40091011J Beijing BINGDU XUEBAO [CHINESE JOURNAL OF VIROLOGY] in Chinese Vol 10 No 2, Jun 94 p 135

[Article by Yao Zhihui [1202 2535 1979] and Yu Yongxin [0205 3057 2450] of the National Institute for the Control of Pharmaceutical and Biological Products, Beijing]

[FBIS Abstract] This paper reports the use of polymerase chain reaction (PCR) for typing 26 isolates of Hantavirus from different geographic regions and different hosts. Total cellular RNA was extracted from virus infected Vero-E6 cell monolayers by the acid guanidium thiocyanate-phenol-chloroform method. One set of primer was designed from a conserved region of S genomic segment and used as genus-specific primers. The other 4 sets of primers were designed from the unique sequences the M segment of each serotype, such that each set was specific either to Hantaan, Seoul, Puumala or Prospect Hill serotype. The results showed that the genus-specific primers could amplify sequences from all 26 Hantaviruses but not from uninfected Vero-E6 cells. Each of the 26 isolates reacted with only one of the 4 sets of primers, among them 16, 7, 1 and 1 isolates belong to Hantaan, Seoul, Puumala and Prospect Hill types respectively. One isolate named "Rr" strain reacted with both Hantaan and Seoul specific primers. The PCR products were analyzed by restriction endonuclease digestion for further confirmation. The results of PCR were consistent with that of serological typing by plaque reduction neutralization test (PRNT). As a new sensitive and specific molecular technique, PCR assay offers a method for the rapid diagnosis and for the accurate typing of new isolates of Hantaviruses.

#### Overexpression of Recombinant Human Fusion Protein IL-6/IL-2 (CH925) in *E. Coli*

40091011K Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 14 No 3, Jun 94 p 167

[Article by Zhao Chunhua [6392 2504 5478], Wang Jiayi [3769 0857 3886], et al. of the Institute of Basic Medical Science, Academy of Military Medical Sciences, Beijing]

[FBIS Abstract] An expression vector encoding the fusion protein IL-6/IL-2 had been constructed by the authors. After the flexible linker was synthesized and ligated with IL-2 gene fragment by PCR amplification, the IL-6 gene fragment was inserted into the upstream of linker-IL-2 sequence. The molecule of IL-6-linker-IL-2 fusion gene was named *E. coli* DH5a/pFIL-6/2 and cloned as well as identified by DNA sequencing. The expressed protein named as CH925 showed a strong band on SDS-PAGE and amounted to 32% of total cell protein. The estimated molecular weight was about

37kD. After renaturation, this fusion protein showed both IL-2 and IL-6 activity, which was assayed by CTLL-2 and 7TD1-dependent cell lines, respectively. The specific activity of IL-2 was  $2.1 \times 10^6$ U/mg, and for IL-6 it was up to  $2.3 \times 10^6$ U/mg.

**Construction of an Aromatic Acid Auxotrophic Attenuated Strain of the Bivalent Hybrid Strain (FS54) of *S. Sonnei* and *S. Flexneri* 2A**

40091011L Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 14 No 3, Jun 94 p 192

[Article by Liu Shihui [0491 1102 6540], Mao Peiji [3029 1014 1015], et al. of the Institute of Microbiology and Epidemiology, Academy of Military Medical Sciences, Beijing]

[FBIS Abstract] The virulent strain of FS54 constructed in this laboratory is a bivalent hybrid strain of *S. sonnei* and *S. flexneri* 2a. Researchers cultured a series of aromatic acid auxotrophic attenuated strains by introducing Tn10 inactivated *aroD* gene into FS54 strain, and successfully eliminated the tetracycline resistant gene (carried by Tn10) and kanamycin resistant gene (carried by Tn5 on form I plasmid pSS120::Tn5). Eventually, a Tc sensitive, Km sensitive aromatic-dependent attenuated bivalent strain of *S. sonnei* and *S. flexneri* 2a, i.e. FS54-7b strain was obtained.

**Study on Some Biological Properties of the Strain of FS54-7b (an Aromatic Acid Auxotrophic Attenuated Bivalent Hybrid Strain of *S. Sonnei* and *S. Flexneri* 2a)**

40091011M Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 14 No 3, Jun 94 p 195

[Article by Liu Shihui [0491 1102 6540], Mao Peiji [3029 1014 1015], et al. of the Institute of Microbiology and Epidemiology, Academy of Military Medical Sciences, Beijing]

[FBIS Abstract] The strain of FS54-7b was an aromatic acid auxotrophic attenuated bivalent hybrid strain of *S. sonnei* and *S. flexneri* 2a constructed in this laboratory. This strain had been eliminated both of the tetracycline resistant gene (carried by Tn10) and the kanamycin resistant gene (carried by Tn5 on form I plasmid pSS120::Tn5). In this paper, some of the biological properties of this attenuated strain in detail were studied. The experiments proved that this strain was safe, non-reverting and maintained the capability to penetrate the epithelial cells. It expressed *S. sonnei* and *S. flexneri* 2a antigens steadily, and conferred a good protection for mice against challenge with virulent *S. Sonnei* 48025-11 strain and virulent *S. flexneri* 2a-12 strain.

**Purification and Physiochemical, Pharmacological Properties of a New Phospholipase A<sub>2</sub> of Fujian *Vipera russelli siamensis* Snake Venom**

40091011N Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA et BIOPHYSICA SINICA] in Chinese Vol 26 No 3, May 94 p 325

[Article by Liu Guangfen [0491 1639 5358], Wang Qingchuan [3769 2532 1557], et al. of the Laboratory of Venoms Research, Fujian Medical College, Fuzhou]

[FBIS Abstract] A new phospholipase A<sub>2</sub> (PLA<sub>2</sub>-3) was isolated and purified from the *Vipera russelli siamensis* snake venom by ion-exchange chromatography and gel filtration. It appeared as a homogeneous protein analyzed by pH 4.3 ordinary, pH 8.9 SDS-polyacrylamide gel electrophoresis and Ouchterlony double diffusion. It was characterized as follows: containing a total of 120 amino acid residues (Trp and 1/2Cys were not determined); molecular weight, 14,800D; isoelectric point, 7.8; PLA<sub>2</sub> specific activity, 255  $\mu$ mol/mg x min; approximate LD<sub>50</sub>, 3.154 mg/kg (iv, in mice). It showed a hypotensive effect in anesthetized rat, and inhibited the rabbit platelet aggregation. It induced reversibly a negative contraction effect on the isolated rat Langendorff heart, but myocardial contracture was not observed. PLA<sub>2</sub>-3 had higher enzyme specific activity and lower toxicity than the toxic PLA<sub>2</sub> and the basic PLA<sub>2</sub> from the same snake venom.

**Preparation of Cross-linked Transferrin-liposomes with Potential Targeting Activity**

40091011O Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA et BIOPHYSICA SINICA] in Chinese Vol 26 No 3, May 94 p 331

[Article by Yang Jingping [2799 7234 1627], Wang Die [3769 3901], et al. of the National Laboratory of Molecular Biology, Shanghai Institute of Biochemistry, Academia Sinica]

[FBIS Abstract] Human transferrin with two molecules of Fe<sup>3+</sup>[HTf(Fe)<sub>2</sub>] was coupled to liposomes membrane by a modified SPDP covalently cross-linking method. The binding capacity of HTf(Fe)<sub>2</sub>-liposomes with the transferrin receptor was similar to that of free-HTf(Fe)<sub>2</sub>. The amount of coupling as measured by <sup>3</sup>H-labeled cholesterol and <sup>125</sup>I-labeled HTf(Fe)<sub>2</sub> was found to be 3.4  $\mu$ g of HTf(Fe)<sub>2</sub>/mg of phospholipid (about 273-2070 HTf(Fe)<sub>2</sub> molecules per 200-1300 nm vesicle). After trichosanthen was entrapped into the HTf(Fe)<sub>2</sub>-liposomes by a freeze-thaw procedure, about 30% of the bound HTf(Fe)<sub>2</sub> remained on the surface of the liposomes. Trichosanthen entrapped into HTf(Fe)<sub>2</sub>-liposomes was 30-fold more effective than trichosanthen entrapped into nonspecific liposomes or free trichosanthen in killing human hepatoma cell line 7721, but not the rat embryo fibroblasts cell line Ref A or the monkey kidney cell line COS. The results indicate that HTf(Fe)<sub>2</sub>-liposomes has targeting effect to tumor cells *in vitro*.



## Computers

**Research Project Yields BJ-1 400 MFLOPS Parallel Computer**

94P60361A Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 25 Jul 94 p 2

[Article by Chen Xiechuan [7115 0588 1557]: "NSFC-Supported Major Achievements in 'Parallel Computers and Parallel Algorithms' Pass Expert Appraisal"]

[FBIS Summary] Achievements from the NSFC-supported major project "Parallel Computers and Parallel Algorithms" passed expert appraisal in Beijing on 12 July. This research, commissioned in June 1989 and conducted by 40-50 scientists at five institutions—the CAS Institute of Computing Technology, the CAS Computing Center, Southeast University, the University of Science & Technology of China, and Fudan University—was directed by CAS Academicians Feng Kang [7458 1660] and Xia Peisu [1115 1014 5126]. The most noteworthy result of this project is the development of a 17-Transputer parallel processing system with a peak speed of 400 million fixed-point operations per second [i.e. 400 MIPS] and the development of the BJ-1 parallel computer, which has a peak speed of 400 million floating-point operations per second (400 MFLOPS) and an architecture combining shared internal memory with message passing.

**Mainland to Exchange Information with Taiwan via Internet**

94P60361B Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 29, 27 Jul 94 p 2

[Article by Bao Gen [1405 8017]: "Both Sides of Straits to Share On-Line Information"]

[FBIS Summary] The Chinese mainland, which recently got a dedicated line to link it up with the Internet international information network, has now become a member of Internet. Since the Taiwan University/Park Academic Network (TANET, established in July 1990) and the S&T network (HINET) of the Taiwan Telecommunications Department's Data Research Institute are members of Internet, academic and S&T circles on both sides of the Taiwan Straits will be able to directly exchange and share information. On this side of the straits, members of the 7-km-circumference Beijing Zhongguancun district distributed fiber optic network—including Qinghua University, Beijing University, and several CAS research organizations—will be able to receive the latest S&T information from around the world, as well as to exchange information with their Taiwan colleagues. According to a recent report in the Taiwan KUNGSHANG SHIHPAO [COMMERCIAL TIMES], this information link between the mainland and Taiwan actually breaks through the Taiwan authorities' ban on "Sant'ung" [three kinds of communications].

**USTND Develops Matrix English-Chinese Machine Translation System**

94P60361C Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 29, 27 Jul 94 p 2

[Article by Xiang Hanyuan [0686 3352 3293]: "New Star Rises in Machine Translation"]

[FBIS Summary] Computer scientists from the University of Science & Technology for National Defense (USTND) Machine Translation Research Group, under the guidance of renowned computer expert Prof. Chen Huowang [7115 3499 2489], recently completed development of the "Matrix" world-class English-Chinese machine translation system (MTS). Running on an IBM PC 386-DX33, the card-expandable Matrix MTS can translate 5000-10,000 English words per minute, a rate 1-2 orders of magnitude [i.e. 10-100 times] faster than comparable MTSs now on the market worldwide. According to the standards of the Japan Electronic Industries Development Association (JEIDA) set forth in its 1992 report on the status of natural language processing worldwide, the translation speed of USTND's Matrix system was the highest in the world.

**Computer-Reproduced Hologram Software Developed**

94P60376A Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 22 Aug 94 p 3

[Article by Liu Jun [0491 6511]: "Computer-Reproduced Hologram Software Developed"]

[FBIS Summary] Shanghai, 20 Aug (XINHUA)—In a State Eighth FYP NSFC-supported software development project entitled "Computer Reproduction of Holograms," a CAS Shanghai Institute of Optics and Fine Mechanics (SIOFM) X-Ray Holography Experimental Group led by CAS Academician Prof. Xu Zhizhan has made a world-class breakthrough. The group has developed a computer-reproduced short-wavelength hologram software package applicable to both X-ray holography and electron-beam holography. This achievement involves a two-step process: first, recording the optical-intensity-distribution data points, stored into the computer, and then the computer digital reproduction of the hologram. This cutting-edge technology, mastered by only a few advanced nations including the U.S. and Germany, has promising applications in three-dimensional imaging and reconfiguration of biologically active cells.

**Software Deal May Breathe Life into Industry**

40100097A Beijing CHINA DAILY in English 3 Sep 94 p 1

[Article by Li Xing: "Software Deal May Breathe Life into the Industry"]

[FBIS Transcribed Excerpt] [Passage omitted] In the midst of such business hoopla, a contract involving an initial investment of 530,000 yuan (\$60,919) signed yesterday between the State Statistics Bureau (SSB) and



the Beijing Hope Computer Company may seem insignificant. But it has made a splash in the country's software industry because SSB is the first central government agency to purchase the rights to commercial software from a computer company. The software to be installed in the more than 6,000 personal computers in SSB's nationwide data network is UCDS3.1, a disk operating system that provides a platform for word and data processing in both Chinese and English as well as supports the applications of most of existing software developed in China and the West.

"SSB has been cooperating with a number of international and domestic computer firms in its effort to achieve the automatic flow and exchanges of statistical information in the country," said Lu Chunheng, Deputy Director of SSB. "And we decided to pay for the right to use Hope's product to support our effort to set up a standardized and universal data bank after we studied more than a dozen similar systems and found that UCDS3.1 was the most suitable to our needs."

But, "by winning the contract, the Chinese computer companies in fact have made big strides in developing commercial software for the market in the country," commented Yan Yixun, Vice-President of the Chinese Academy of Sciences. PCs began to enter offices and homes in China nearly 10 years ago.

"It saves a lot of time and work in computation and analysis within the SSB and its branches," Lu said. "And it's so efficient that staff employees in several county SSB branches which lack country government financing have themselves pooled their money to buy PCs for office work." However, despite predictions that China has great potential in developing commercial software, the country's software industry has been developing at a slow pace, Yan said.

Most software in use today in China is not sold over the counter. Some has been installed in PCs by the companies selling the hardware. Other programmes have been specially commissioned and usually feature limited applications that have no market outside the commissioning enterprises or government agencies.

Software companies have made money from commissioned projects, as Hope did a few years ago by developing a system for the secretariat of the State Council, and as Founders Corporation has been doing for the past six years with its computer publishing systems for Chinese-language print media around the world. But in general, Chinese companies creating commercial software have had a difficult time promoting their products. Thus, the SSB's purchase of the right to use Hope's software in its nationwide PC network has been viewed as a role model in the protection of intellectual property rights.

"We hope that society will follow suit so as to develop the software industry into one of the largest industries in the country," said Zhang Yungang, President of China Sciences Group Corp.

### Super-PC-Based SAR Imaging Processor

94P60379A Beijing DIANZI KEXUE XUEKAN  
[JOURNAL OF ELECTRONICS] in Chinese Vol 16  
No 4, Jul 94 pp 444-448

[Article by Peng Hailiang (1756 3189 5328), Zhu Minhui (2612 2404 1979) et al. of the CAS Institute of Electronics, Beijing 100080: "Supermicrocomputer-Based SAR Imaging Processor," supported by grant from SSTC's 863 High-Tech Program; MS received 28 Dec 93, revised 23 Feb 94]

[FBIS Abstract] A novel super-PC-based SAR (synthetic aperture radar) imaging processor is presented and its system configuration and software design are analyzed in detail. Advantages of this RISC-based processor—which has peak single-precision and double-precision processing speeds of 80 MFLOPS and 40 MFLOPS, respectively, and which runs a 1000-point FFT in 0.8 ms—are proven by experimental results.

The processor, intended for 100 km x 100 km SAR data, has the hardware configuration shown in Figure 1 below. In the figure, EXABYTE refers to the EXABYTE ST8500 8mm cassette tape drive (5 GB capacity per tape). The abundant development software runs under both DOS and UNIX. The RISC compiler supports FORTRAN, C, C++, and Pascal. The EISA bus has a peak transmission speed of 33 MB/s; the SCSI bus, for interfacing with peripherals, has a peak transmission speed of 10 MB/s; the LAN has a 10 Mbps transmission speed; and the TMS34020 image processing card is designed for 48-cm 1280 x 1024 x 256-pixel color image displays. Figures 2 and 3, not reproduced, show a schematic of the processor software configuration and a photograph of an ERS-1 SAR image, respectively. Tables 1-3, not reproduced, show FFT operating times, capacities for four types (SEASAT-A, ERS-1, ALMAZ-1, and JERS-1) of satellite-captured SAR data, and imaging processing times (4h, 3h, 0.6 h, and 2 h, respectively) for the four types. Complete data given in Table 4—test results for three image indicators—is as follows: range resolution in m for the four types is 36.4,

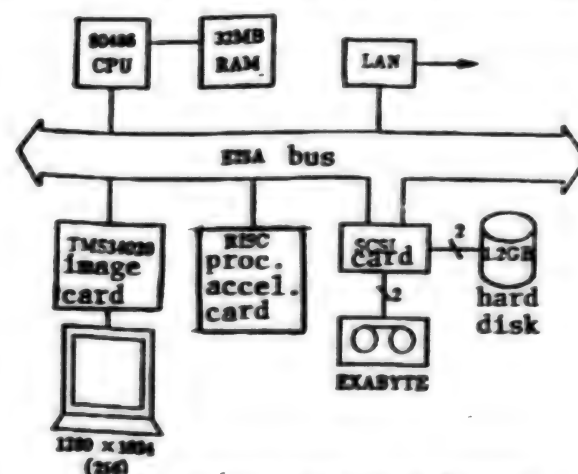


Figure 1. Processor Hardware Configuration

29.5, 13.0, and 28.7, respectively; bearing resolution in m for the four types is 26.8 (4 looks), 25.5 (4 looks), 16.0 (2 looks), and 29.3 (4 looks), respectively, and radiation resolution in dB for the four types is 2.08 (4 looks), 2.06 (4 looks), 2.73 (2 looks), and 2.16 (4 looks), respectively.

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2. Wu C., Liu, K.Y., Jin, M., IEEE TRANS. ON AES, 1982, AES-18(5):563-574.
3. Rabiner, L.R., Gould, B., "Theory and Application of Digital Signal Processing," Prentice-Hall, 1975.

### Defense Technology

#### New Methods for Extending Frequency Band of RAM Coatings

94P60342A Chengdu DIANZI KEJI DAXUE XUEBAO [JOURNAL OF UNIVERSITY OF ELECTRONIC SCIENCE AND TECHNOLOGY OF CHINA] in Chinese Vol 23 No 3, Jun 94 pp 264-268

[Article by Zhao Bolin [6392 0130 3829] and Rao Kejin [7437 0344 6210], Institute of Information Materials Engineering, UESTC, Chengdu 610054: "New Methods for Extending Frequency Band of Radar Absorbing Material Coatings," supported by grant from MEI's Basic Research Fund; MS received 5 Jan 94, revised 24 Jan 94]

[FBIS Abstract] To extend the frequency band of radar absorbing material [RAM] coatings, the frequency characteristics and intrinsic bandwidth of the coatings are analyzed. Two new methods—frequency compensation and frequency tracking—are proposed for extending the low-reflection (high-absorption) frequency band according to the coating's dispersive characteristics. Computer simulation results indicating efficiencies of these two methods are given.

Figure 1 below shows the structure of a multilayer coating;  $\mu[i]$ ,  $\epsilon[i]$ , and  $d_i$  ( $i=1, 2, \dots, N$ ) are the relative complex permeability, the relative complex dielectric constant (i.e., permittivity), and the thickness, respectively, of the  $i$ th layer in an  $N$ -layer coating. Figure 2 below shows the frequency characteristics of the coating input impedance  $Z_{in}$  for two sets of values of  $\mu[i]$  and  $\epsilon[i]$ ; the argument of  $Z_{in}$  is the left vertical axis while the magnitude of  $Z_{in}$  is the right vertical axis. Figure 3 below shows the frequency response of the coating reflection coefficient  $\Gamma$  for a 0.001-m thick one-layer coating (curve 1) and for two different two-layer coatings, the first with a total thickness of 0.001 m (curve 2) and the second with a total thickness of 0.0015 m (curve 3). It can be seen that in the 8-18-GHz range, the single-layer coating has a -10 dB reflectivity bandwidth of only 6 GHz and a -8 dB

bandwidth of only 7 GHz; low-end performance is especially poor (reflectivity is only -5 dB at 8 GHz). While the thinner two-layer coating (curve 2) produces a similar result, the thicker two-layer coating (curve 3) yields a marked improvement: a -10 dB reflectivity bandwidth of 7.5 GHz and a -8 dB bandwidth of 9 GHz. Simply increasing the multilayer coating thickness, however, is of limited value because added weight and reduced flexibility become negative factors.

In the frequency compensation method, the poor low-end (near 8 GHz) absorption performance of a single-layer coating is compensated for by utilizing hexagonal ferrite RAM, a magnetic lossy material, doped with just the right amount of second-order or fourth-order metal ions to control the natural resonance frequency of the hexagonal ferrite material and thereby raise the value of  $\mu[i]$ , for frequencies near 8 GHz. Computer simulation results for this method are given below in Figure 4. In the 8-9-GHz range,  $\mu[i]$  is high (1.9-j1.6); it falls below 1.55-j1 at higher frequencies. Also,  $\epsilon[i]$  is held constant at 16-j0.5,  $d=0.001$  m, -10 dB reflectivity bandwidth has grown to 10 GHz (from 9 to 19 GHz) and -8 dB bandwidth has grown to 12 GHz (from 8 to 20 GHz).

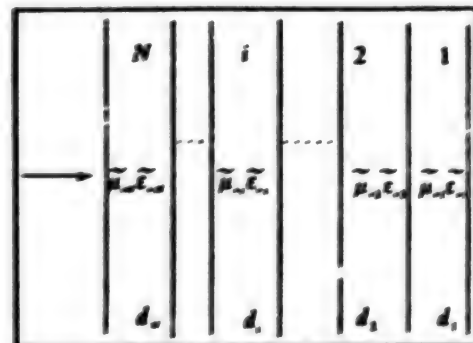


Figure 1. Coating Structure

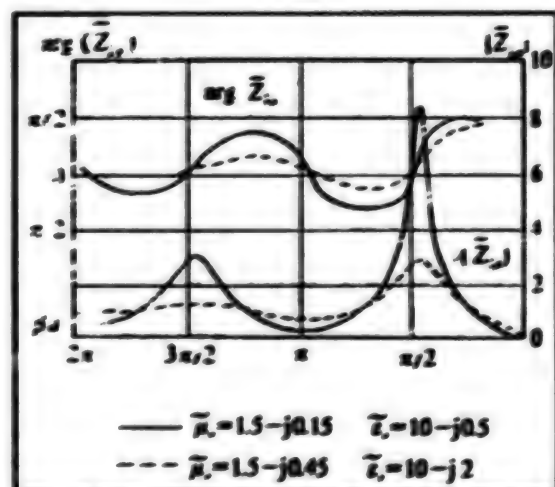


Figure 2. Frequency Characteristics of Coating Input Impedance

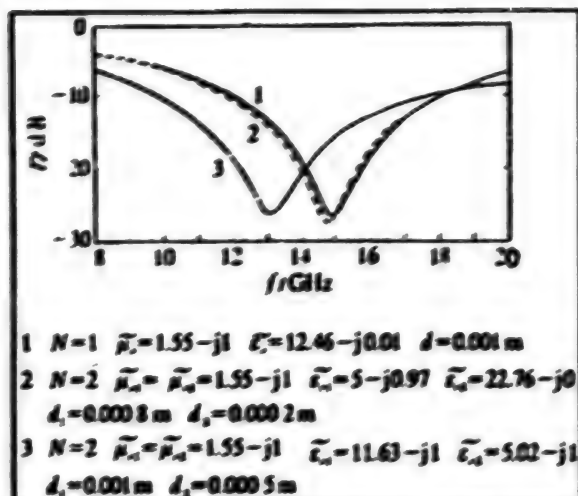


Figure 3. Coating Reflectivity Frequency Response ( $\mu_r$ ,  $\epsilon_r$  constant)

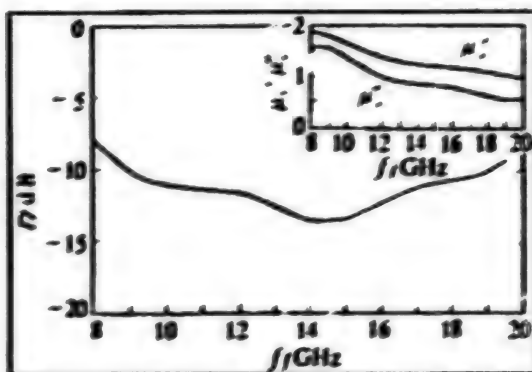


Figure 4. Coating Reflectivity Frequency Response (with  $\mu_r$  varying as a function of frequency)

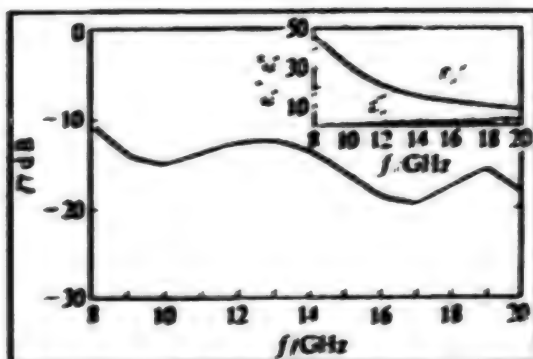


Figure 5. Coating Reflectivity Frequency Response (with  $\epsilon_r$  varying as a function of frequency)

In the frequency tracking method,  $\epsilon_r$  is now varied as a function of frequency, while  $\mu_r$  is held constant at  $1.5-j0.5$ . The key to this method is the technique given in reference [3], where short metal fibers are dispersed in a ferrite-resin composite. Results of a computer simulation are given in Figure 5: for a one-layer coating (thickness held constant at 0.001 m), reflectivity is -10 dB or better over the entire 8-20-GHz range (i.e., -10 dB reflectivity bandwidth is now at least 12 GHz).

There are no tables.

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#### Domestic GPS-Based Moving-Target Monitoring/Alarm System Certified

94P60378A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 5 Aug 94 p 2

[Article by Yang Zhaobo [2799 0340 3134]: "China Develops KXJ-II Moving-Target Satellite Positioning Monitoring/Alarm System"]

[FBIS Summary] Zhuhai, 4 Aug (XINHUA dispatch)—In an effort to provide public security officers with a means to counteract the growing criminal activity in stolen vehicles, Zhuhai Municipal Kexing [4430 2502] High-Tech Development Ltd. has developed the KXJ-II moving-target satellite positioning monitoring/alarm system, which recently was certified. The system consists of two parts: the space satellite system and the ground control system. The space system uses the U.S. GPS (global positioning system) network. The ground control system in turn consists of two parts: central control equipment and vehicle-carried equipment. Via the GPS, the ground control system can at any time get a fix on the moving target's position, which will be displayed on an electronic map in the central control room. Within 2 seconds from the time it receives the vehicle's alert, the control center can issue an alarm, including the [target's] geographical position, vehicle type, vehicle model, and other important data, and display this data on monitor screens. The central control portion of the overall system incorporates multimedia computer technology, with touch screens and word prompts that can be quickly learned by non-computer-specialists. Personnel in the field portion—the public security vehicles—can also quickly learn operation of the system, described in a manual, without special training.



## Lasers, Sensors, Optics

## New Infrared Detectors Developed

## 9-Micron Ge-Si-Si Internal Photoemission IR Detector

94P60352A Shanghai HONGWAI YU HAOMIBO XUEBAO [JOURNAL OF INFRARED AND MILLIMETER WAVES] in Chinese Vol 13 No 2, Apr 94 pp 149-152

[Article by Gong Dawei [7895 1129 5898], Lu Xuekun [4151 1331 0981], et al., Surface Physics Laboratory, Fudan University, Shanghai 200433, and Zhou Tao [0719 3447], Ye Hongjuan [0673 4767 1227], and Shen Xuechu [3088 1331 4342], Infrared Physics Laboratory, Shanghai Institute of Technical Physics (SITP), CAS, Shanghai 200083: "p<sup>+</sup>-Ge<sub>x</sub>Si<sub>1-x</sub>/p-Si Heterojunction Internal Photoemission IR Detector With 9  $\mu$ m Cut-off Wavelength," supported by grant from NSFC; MS received 30 Apr 93, revised 18 Jan 94]

[FBIS Abstract] The p<sup>+</sup>-Ge<sub>x</sub>Si<sub>1-x</sub>/p-Si heterojunction internal photoemission IR detector is a new type of tunable-cutoff-wavelength IR detector, especially appropriate for use in IR CCD planar arrays operating in the 8-12  $\mu$ m atmospheric adsorption window. Using an MBE technique to grow the p<sup>+</sup>-Ge-Si alloy layer on a p-type Si(100) substrate, the authors have fabricated a p<sup>+</sup>-Ge<sub>x</sub>Si<sub>1-x</sub>/p-Si heterojunction internal photoemission IR detector with a cutoff response wavelength of 9  $\mu$ m, a 52K (operating temperature) detectivity D<sup>\*</sup><sub>500K</sub> (500K black-body temperature) of  $2.0 \times 10^8 \text{ cm}^2 \cdot \text{Hz}^{1/2} / \text{W}$ , 40K (operating temperature) detectivity D<sup>\*</sup><sub>1000K</sub> (1000K black-body temperature) of  $1.0 \times 10^9 \text{ cm}^2 \cdot \text{Hz}^{1/2} / \text{W}$ , and a 52K (operating temperature) voltage responsivity R<sub>v500K</sub> of  $3.3 \times 10^3 \text{ V/W}$ . The p<sup>+</sup>-Ge<sub>x</sub>Si<sub>1-x</sub> alloy layer was grown in a Riber SSC ultrahigh-vacuum evaporation system at the Fudan University Surface Physics Laboratory. In this process, B<sub>2</sub>O<sub>3</sub> was used as the p<sup>+</sup> dopant, producing a carrier concentration of  $1 \times 10^{20} / \text{cm}^3$  in the alloy layer (after doping).

Figure 1, reproduced below, shows a schematic cross section of the device. Figure 2, not reproduced, shows a graph of a detector photoresponse measured by an FTIR spectrometer at 50K; in the graph, voltage responsivity R<sub>v</sub> falls to zero above 9  $\mu$ m. There are no tables.



Figure 1. Schematic Cross Section of Device

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1. Liu, H.C., Li, Lujian, Baribeau, J.M., et al., *J. Appl. Phys.*, 1992, 71(4):2039.
2. Overstraeten, R.J., van, Mertens, R.P., *Solid State Electron.*, 1987,30:1077.

## Thin-Film Thermopile IR Detector

94P60352B Shanghai HONGWAI YU HAOMIBO XUEBAO [JOURNAL OF INFRARED AND MILLIMETER WAVES] in Chinese Vol 13 No 2, Apr 94 pp 157-160

[Article by Sun Tietun [1327 6993 0937] and Zhou Nansheng [0719 0589 3932], Microelectronics Institute, Xidian University, Xian, Shaanxi Province 710071: "Development of a New Type of Thin-film Thermopile Infrared Detector"; MS received 22 Sep 93, revised 4 Jan 94]

[FBIS Abstract] The thermopile IR detector, with excellent dc stability and a broad (UV to far-IR) spectral response, is a proven device for measuring thermal radiation. In this paper, a newly designed two-sided thin-film thermopile IR detector—one side being the absorption layer and the other side being the sensitive area—is introduced. This new device, which comes in a T0-5 package, is fabricated with standard semiconductor techniques: photolithography, etching, and deposition. The  $\phi$  device sample, which consists of 15 thermocouples on a 1-mm diameter round operating surface, has an integration density of  $22 / \text{cm}^2$ , a responsivity of 30-50 V/W, a relaxation time of 70-120 ms, and a spectral response range of 8-14  $\mu$ m (UV to IR) due to its window material, KBr.

Figures 1-3 show the geometry of the sensitive area, a cross section of the new thermopile, and the geometry of the chip assembly, respectively. Table 1, reproduced below, lists five structural and performance parameters for the new thermopile detector, a thermopile IR detector with the traditional structure, and the Swedish-made AGA sample.

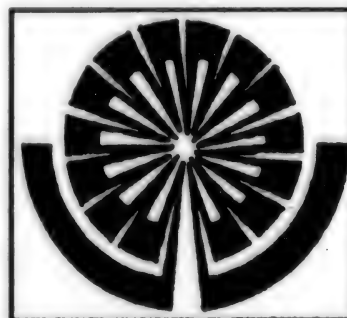


Figure 1. Geometry of Sensitive Area

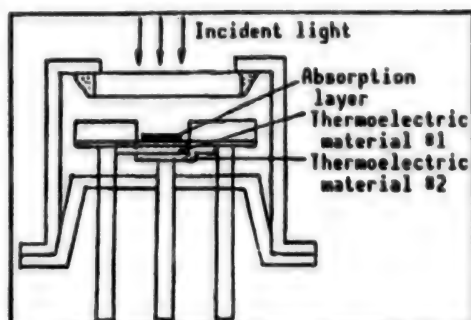


Figure 2. Profile of New Type Thermopile

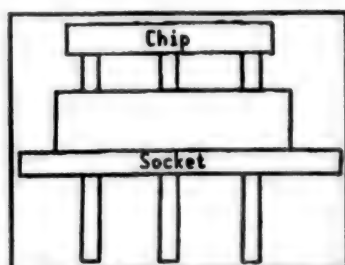


Figure 3. Geometry of Chip Assembly

Table 1. Structural and Performance Comparison of Some Thermopile Detectors

Parameter	Value		
	Sample with new design	Sample with traditional structure	Sample made by Swedish firm AGA
Photosensitive surface diameter (mm)	1	3	1
Integration Density (Number of thermocouples/mm <sup>2</sup> )	22	5	22
Spectral response range (μm)	8-14	Broad	8-14
Responsivity (V/W)	30-50	15	35
Resistance (kΩ)	3-5	4	4.2

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1. Charles, E., Groubert, E., Boyrer, A., *Sensors and Actuators*, 1988, 13:131-137.
2. Volklein, F., Wiegand, A., *Sensors and Actuators*, 1990, A24:1-4.
3. Wu Jie, "Photoelectric Signals and Detection" [in Chinese], Harbin: Harbin Institute of Technology Publ. House, 1990, 47-63.

4. Ge Qiaoyi, Yiqi Yibiao [Instruments and Meters], 1980, 1:26-29.

#### Microelectronics

##### Nation's First GaAs 600-Gate Gate Arrays Developed by CAS Institute

94P60383B Shanghai WEN HUI BAO in Chinese  
24 Aug 94 p 1

[Article by Huang Xin [7806 6580]: "New Achievement in Domestic Research on Microelectronics Technology"]

[FBIS Summary] Researchers at the CAS Shanghai Institute of Metallurgy have realized a major achievement with their development of the nation's first gallium arsenide (GaAs) 600-gate gate array ICs, which were certified by CAS a few days ago.

These GaAs gate arrays, developed in a State Eighth FYP key microelectronics project that breaks through the foreign blockade on this technology, will provide impetus to domestic R&D of GaAs LSI application-specific integrated circuits [ASICs]. During the development process, the institute researchers perfected and applied a macrocell library, a GaAs IC functional design library, and a simulation system.

##### More on First Domestic 600-Gate GaAs Gate Arrays

94P60387A Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 26 Aug 94 p 1

[Article by Huang Xin [7806 6580]: "600-Gate Gallium Arsenide Gate Array Circuits Unveiled"]

[Editorial Report] Additional details on China's first domestically developed 600-gate GaAs gate arrays are as follows: these chips are based on depletion-mode GaAs MESFET [metal-semiconductor field-effect transistor] process technology and dual-layer metal wiring technology. They employ the SDFL [Schottky diode field-effect transistor logic] logic cell.

##### State IC Specialized Equipment Development Base Set for Shanghai

94P60383A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Aug 94 p 2

[Article by Chen Qin [7115 0530]: "State Integrated Circuit Specialized Equipment Development Base to Be Located in Pudong"]

[FBIS Summary] Shanghai, 18 Aug (XINHUA)—The contract for the construction of the State Large-Scale IC (LSI) Specialized Equipment Development Base was signed the other day. This LSI manufacturing equipment development base, to be located in the Zhangjiang High-Tech Park of Shanghai's Pudong New Area, will occupy 58,000 square meters of land and is funded with a

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first-phase investment of 210 million yuan. Some of MEI's enterprises and research institutes will send representatives to the new base to engage in R&D and production of equipment, test instruments, and specialized materials for LSI manufacturing.

#### **Further Details on Chinese R&D of Piezoelectric/Electrostrictive Microactuators**

94P60341A Beijing GAO JISHU TONGXUN [HIGH TECHNOLOGY LETTERS] in Chinese Vol 4 No 6, Jun 94 pp 37-40

[Article by Cai Hegao [5591 7729 4108], Sun Lining [1327 4539 1337], and An Hui [1344 6540] of the Robotics Research Institute, Harbin Institute of Technology, Harbin 150001: "Piezoelectric/Electrostrictive Microactuators and Their Applications, Part 2 (of 2)"; MS receipt date not given. Part 1 is abstracted in JPRS-CST-94-014, 24 Aug 94 pp 57-58]

[FBIS Abstract] Applications of microactuators in seven areas are given: precision machining (machine tool cutter compensation mechanisms), optical fiber butt coupling, bioengineering (especially genetic engineering, medicine, and embryology), scanning tunneling microscopy (STM), ultrasonic electric machines, precision work benches, and robot precision manipulators (i.e. micromanipulators).

In the first area, precision machining, the University of Science & Technology for National Defense (USTND) in 1986 developed a lathe compensation mechanism with a run of 20 microns, a resolution of 0.1 micron, and a repeat positioning accuracy of +/- 0.1 micron. Harbin Institute of Technology (HIT), Nanjing Engineering Institute, and other domestic institutions have in recent years developed lathe microfeed mechanisms based on electrostrictive ceramic drive. In the same period, Dalian University of Technology, Institute 303 of the former Ministry of Aerospace Industry, and HIT have separately developed piezoelectric ceramic-drive and electrostrictive ceramic-drive precision grinder microfeed mechanisms.

In the fourth area, STM technique, Shanghai's Fudan University, Xian Jiaotong University, Qinghua University, Chongqing University's Applied Physics Institute, the CAS Institute of Physics, the CAS Scientific Instruments Plant, and other domestic units have all made significant progress. Similarly, in the fifth area, high-power ultrasonic vibrational-coupling-type electric machines (i.e. motors), Qinghua University, the CAS Institute of Acoustics, HIT, the Harbin Academy of Ship Engineering, and other domestic institutions since the early 90s have conducted a series of initial experiments which at present remain at the laboratory research phase.

In the sixth area, precision work benches, Qinghua University has developed a 2-degrees-of-freedom vernier work bench with a flexible electrostrictive microactuator

drive; this bench has two parallel four-bar linkage mechanisms that can separately move in the x and y directions. Basic technical indicators for this precision bench are as follows: size range is 13 x 10 x 2 dm [as published], run range is 0-10 microns, and positioning accuracy is +/- 0.03 micron. [Professor Yang Yimin at] Guangdong Institute of Technology (GIT) in 1991 developed a bionic step-by-step rectilinear actuator with a step length of 0.1-10 microns, a step error of 0.1 micron, a maximum run of 30 mm, a maximum output force of 30 N, and dimensions of 32 mm x 47 mm x 138 mm. [Cf. JPRS-CST-94-013, 25 Jul 94 pp 22-23].

In the final area, robot micromanipulators, domestic units are actively engaged in R&D. Development of microdrivers, microrobots, and vernier robots has been included in the Intelligent Robotics topical area of the State 863 High-Tech Program. GIT has developed one-dimensional and two-dimensional ganged piezoelectric ceramic-drive microdrivers with displacement ranges of 50 microns and 50 x 50 microns, respectively. Based on these achievements, GIT developed a 3-degrees-of-freedom piezoelectric ceramic-drive microrobot with a displacement range of 50 x 50 x 50 microns and an accuracy of 0.1 micron. Also, in research projects conducted over a 3-year period, HIT has developed an electrostrictive large-run ultraprecise planar microdriver. This microdriver has an X- and Y-direction movement range of 10 mm and a displacement resolution of 0.01 micron. This microdriver and the PUMA 562 robot have been joined to form a macro/micromanipulator system, which has been successfully used for assembly/installation of precision hydraulic valves.

Three figures show examples of microactuator applications in the aforementioned areas 2 and 5. There are no tables or references.

### **Telecommunications**

#### **More Reports on Information Highway/Mobile Communications**

##### **Fibre-Optic Cable to Improve NW Telecom**

40100093 Beijing CHINA DAILY in English 19 Aug 94 p 1

[FBIS Transcribed Text] The days of jammed telecommunications to the northwestern provinces and autonomous regions are numbered, thanks to a high-capacity, fibre-optic cable that is scheduled to go into official operation next month.

The 3,130-kilometre cable which runs from Xi'an in Shaanxi Province, to Lanzhou in Gansu Province and on to Urumqi in the Xinjiang Uygur Autonomous Region has been completed and went into trial operation yesterday.

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Experts and technicians are busy testing the cable to guarantee smooth telecommunications service for the Third Urumqi Trade Fair scheduled for next month, according to an official from the Ministry of Posts and Telecommunications.

The fibre-optic cable, which cost 792.6 million yuan (\$92 million), will initially provide 64,080 long-distance lines.

The project was partially funded with \$39.53 million in governmental loans from Australia. In return for the funds, the fibre-optic cable and some other equipment were imported from Australia.

At present, there are only 50 telephone lines and 216 satellite telecom lines linking Urumqi with other parts of the country. Customers constantly complain that "nothing is more difficult than making a call to Urumqi," the official said.

Statistics from the ministry showed that only 3 per cent of phone calls to Urumqi could be connected, greatly restricting economic development in the northwestern part of the country, particularly Xinjiang.

The official said that construction of the project, which started in April, is incredibly difficult because almost the entire length of the cable traverses boundless Gobi and other deserts.

The cable will serve as part of the proposed 16,000-kilometre Asia-Europe optic cable, running from Shanghai to Frankfurt through 11 countries including China, Kazakhstan, Iran, Ukraine, Poland and Germany.

The official said that the Xi'an-Lanzhou-Urumqi line is one of 22 trunk fibre-optic cables which will eventually form a highly efficient telecom network across China.

The Xi'an-Chengdu and Beijing-Shenyang-Changchun-Harbin optic cables were finished and put into trial operation last month.

At present, 38,660 kilometres of trunk optic cables are in operation across the country.

The ministry expects that \$7 billion in foreign investment and loans will be used by the year 2000 to assist in the construction of the network.

The ministry's planned investment in the sector this year is 53.6 billion yuan (\$6.2 billion), a marginal increase over that of last year.

It is estimated that the switchboard capacity of telephone network will reach over 140 million lines by the year 2000.

#### One Phone for Every 2 Beijingers by 2000

40100096A Beijing CHINA DAILY in English  
25 Aug 94 p 3

[Article by Gao Jin'an]

[FBIS Transcribed Text] There will be one phone for every two residents in Beijing by the turn of the

century, according to an ambitious plan announced recently.

Currently there is only one phone per four people in the capital.

Switchboard capacity is expected to rise from 1.3 million to 6 million lines by the year 2000.

The network will support more than 5 million telephone users, and residents that want phones will no longer have to wait, the Beijing Telecommunications Administration (BTA) said.

At present, many Beijingers have no idea how long they have to wait for their phones.

Although 170,000 telephones were installed in the first half of the year, it is estimated that at least 100,000 applicants remain on the city's waiting list.

BTA officials said they will install at least 300,000 telephones this year, but there is little chance that the waiting list will be cut as more families sign up for new lines.

To cope with the expansion plan, seven-digit telephone numbers in the city will become eight-digits in 1997, the officials added.

In the first phase of the plan, BTA plans to increase the exchange capacity from 1.3 million to 1.7 million lines by the end of this year and expand the number of telephone users from 832,000 to over 1 million.

Beijing has one phone for every four people, ranking it first among all municipalities and provincial cities.

The officials said the number of cellular phones will reach 500,000 by the turn of the century. At present, there are 60,000 cellular phones in the capital.

Earlier last month, the last group of 5,556 electromechanical telephone users were switched to a programme-controlled telephone bureau in the city, making all transmission in the city digitized.

The Beijing telecom network, serving 11 million people and organizations on 16,800 square kilometres, is the largest urban telephone network in the country.

Direct telephone access is available to 204 countries and regions as well as more than 2,000 cities and towns in China.

The fast expansion and development of the telephone network has also helped the development of data communications, video telephone systems, information retrieval, voice mail and electronic mail.

#### AT&T Increases Presence in Telecom Industry

40100096B Beijing CHINA DAILY (BUSINESS WEEKLY) in English 29 Aug 94 p 2

[Article by Liu Weiling]

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[FBIS Transcribed Text] U.S. telecommunications giant AT&T said it will introduce more information technology to help China build its information super-highway.

"The most important mission of our company (here) is to bring our information technology and localize the technologies to serve the nation's economic development," said K.H. Wun, managing director of AT&T Global Information Service's Asia Pacific China region.

Wun said China's dynamic economic growth is generating surging demand for information technology. He said AT&T, backed with Bell Laboratories, is ready to launch more co-operation in this field.

As an important step toward China's information market, the company signed a contract last week to help Xinhua News Agency, China's biggest news organization, to build an information network to cover the whole country.

The first phase of the network, slated to be completed within the year, will cover all of the country's provincial capitals and municipalities.

It is also expected to stretch to counties and even townships across the country.

"China's energetic economic development is screaming for improved information service," said Zhang Baoshun, deputy president of Xinhua.

The information network will provide economic, scientific and technology information to government organizations, research institutes, universities, enterprises and other organizations, Zhang said.

"We are building this network as a good opportunity to help push China's construction of the information industry," said Wun.

"This will help us reinforce our commitment in the country," he said.

AT&T has already set up nine joint ventures in the country. They are engaged in marketing wireless systems, international long-distance services and computer products and networks.

The company also plans to invest \$150 million and triple its 800-strong staff in China over the next two years.

#### **IBM Enters Hi-Tech JV to Assist Golden Plan**

40100096C Beijing CHINA DAILY in English  
30 Aug 94 p 2

[Article by Pei Jianfeng]

[FBIS Transcribed Text] IBM China Co. and Ji Tong Communication Co. signed an agreement yesterday to set up a hi-tech joint venture, Jilong Information Network Research and Development (Beijing) Company.

The registered capital of Jilong is \$9 million with IBM and Ji Tong each holding a 50 per cent stake.

Both sides are set to invest more money in the venture in the coming years, said Ji Tong President Lu Shouqun.

Visiting US Secretary of Commerce Ron Brown and Hu Qili, Electronics Industry Minister, attended the signing ceremony.

The joint venture was established to support the Three Golden projects, which aims to build a modern, nationwide information infrastructure in China.

The Three Golden projects include: the Golden Bridge—a network combining satellites and fibre optics for data, voice and image transmission; the Golden Customs—a foreign trade network; and the Golden Card—an electronic money network and national credit card system.

Jilong will introduce IBM's advanced network and open system technologies to develop an advanced data network for the Golden Bridge project.

Ji Tong, established by the Ministry of Electronics Industry, is responsible for the construction of the Golden Bridge and Golden Customs projects and also is undertaking the pilot work for the Golden Card project.

The construction of the Golden Bridge project, which will be the core of China's information superhighway, will formally be kicked off next month, Lu revealed.

"The construction of the huge project needs close cooperation between domestic companies and international giants like IBM, which leads the development and direction of the information technology industry," said Lu.

Robert Savage, chairman of IBM China Co., said that the joint venture demonstrates IBM's long-term commitment to China.

#### **China To Get into Internet via SprintLink**

40100096D Beijing CHINA DAILY in English  
31 Aug 94 p 2

[Article by Li Yan]

[FBIS Transcribed Text] U.S. telecommunication company Sprint has signed an agreement with the Ministry of Post and Telecommunications (MPT) providing China with access to the Internet.

The agreement, signed yesterday with the Directorate General of Telecommunications (DGT), allows China access to the Internet's global network of 20,000 networks and over 2 million host computers worldwide.

The agreement was inked in Beijing by DGT Director Luan Zhengxi and Sprint Chairman and Chief Executive Officer William T. Esrey. Visiting US Secretary of Commerce Ron Brown attended the signing ceremony.

Esrey is a member of the commercial mission to China with Brown.

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The new service, Global SprintLink, will be provided via the country's international gateways, the Beijing and Shanghai post and telecommunications administrations, which are also regional arms of MPT. The service will enable MPT branches to process information more efficiently.

DGT will pay a fee for the Sprint service. But precise figures are not available.

"Today's agreement is a decisive step towards the overall economic development of China," Esrey said at the ceremony.

The agreement will enable China to be connected with the global information superhighway, helping the country to strengthen economic and commercial ties with its foreign partners.

China is currently making efforts to build its own information superhighway in response to the country's rapid economic growth and closer trade and economic ties with foreign countries.

China's telecommunication market is "enormous," Esrey said.

Under such conditions, Esrey said, Sprint wants to play a big role in China's telecommunications development.

To further boost its business, Sprint will establish two offices in Shanghai and Guangzhou by the end of the year.

Esrey said that China, with its fast-growing economy and its huge population, deserved to become a global partner of the Internet.

Meanwhile, Sprint has also set up voice and data services directly with MPT and DGT, including a direct connect facility between the United States and China for international direct distance dialing services.

In another development, TRW Inc., also a member of the Brown-led delegation, yesterday signed an agreement with the Beijing Cable TV Network to supply one million descrambler units.

It also signed a memorandum of understanding with the Jinan Auto-Accessories Works of Shandong Province on jointly manufacturing engine valves for the growing Chinese automotive market.

#### **Nokia Has Market Covered Four Ways**

40100096E Beijing CHINA DAILY in English 1 Sep 94  
p 9

[FBIS Transcribed Text] Nokia's philosophy is connecting people.

The international telecommunications and electronics group sells cellular phones, digital telephone exchanges, telecommunications networks, colour television sets, monitors, cat electronics, cables and cable machinery.

The group has four subsidiaries: Nokia Telecommunications, Nokia Mobile Phones, Nokia Consumer Electronics and Nokia Cables and Machinery.

The group is playing close attention to the China market and supplies dedicated telecommunications networks, mobile phones, cables and cable machinery to China.

Nokia Telecommunications supplies telecommunications systems and equipment based on advanced technology for use in fixed and mobile phone networks, including digital exchanges, transmission systems and base stations.

Nokia Consumer Electronics places great importance on the user-friendliness of its products.

Nokia is a famous brand in Europe in both consumer electronics products and monitors. Its products include car audio systems, control electronics for airbags and new-generation television sets. Nokia Cables and Machinery manufactures cables, cable machines, aluminium profiles and cable harnesses.

Nokia is the world's leading supplier of cable machinery. It is also involved in product development of new optical fibre applications and high voltage and radio frequency cables.

Nokia is a leading player in the field of pagers and mobile phones, today's most popular telecommunications products.

Nokia Mobile Phones is Europe's largest and the world's second-largest cellular mobile telephone manufacturer.

Its products can be found in more than 90 countries worldwide and are sold through its own subsidiaries and joint ventures in 16 different countries.

In order to meet the challenges of changing technology and a growing market, Nokia must be able to react quickly to market demand and remain flexible. Therefore, it maintains a worldwide research and development, production, logistics and sales network.

Nokia Mobile Phones also manufactures and markets mobile phones for all the world's major analog networks. As a pioneer in digital technology, it developed one of the first GSM phones and cellular mobile phone networks in the world.

In China, Nokia is also taking an active role. In 1992, it provided digital exchanges, radio links and transmission systems—as well as installation, commissioning and training for Daqing Oilfield.

As a result, Nokia received a \$30 million order for transmission equipment and optical cables.

The systems and cables were installed in the provinces of Guangxi, Shandong and Zhejiang. The order also included a large training package and overall supervision.

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In April 1992, Nokia signed a joint venture contract with Guilin Institute of Optical Communications producing optical terminal equipment such as Nokia's Dynacard, Muxcard and Linecard transmission equipment.

In December 1993, China Railways placed an order, worth more than \$7 million, with Nokia Telecommunications for the supply of digital switching and transmission equipment for the Zhengzhou, Lanzhou and Jinan railway bureaus of the Railway Ministry of China. The equipment was an integral part of the railway projects for Baoji Zhongmei and Jiaoxian-Huangdao.

In May this year, Nokia Telecommunications and the Beijing Telecommunications Administration signed a contract to supply a GSM (Global System for Mobile Communications) digital cellular network to Beijing.

Under the agreement, Nokia will supply a DX 200 mobile switching centre, register units, GSM base stations and base station controllers as well as a DX 200 operation and maintenance centre. It will also supply a short message service system, voice mail system and mobile phones.

The Beijing Telecommunications Administration GSM network will start late this year with 10 base stations covering most of the Beijing City area. The capacity of the first phase is 10,000 subscribers. This contract further strengthens the position of both GSM and Nokia in the digital cellular network in Asia.

It is expected that other provinces will follow Beijing when they make their network choices. Nokia is now delivering GSM equipment to Thailand, Philippines and Hong Kong.

The paging business is also taking wing for Nokia. In 1993, Nokia Paging, which is part of Nokia Mobile Phones, secured a major deal with Guangdong Soon-phone Information United Corporation to supply Radio Data System (RDS) pagers to Guangdong.

"Nokia pagers are very suitable for China because they use the FM broadcasting network, which is efficient and provides wide coverage in the Guangdong region," Nokia Paging general manager Pertti Simovaara said.

"Guangdong is the first province where RDS paging services are available. I believe that the same concept can be applied to other areas of China. The market outlook is very bright."

Nokia's FM paging is used in 11 countries and its compact size and modern design are widely recognized.

Nokia 121 is a distinct analog product with huge potential in China. It is a microportable phone with the weight of only 275 grams together with a slim-line battery only 2.2 cm thick. It has strength indicator and battery level indicator, and auto-redialling function.

Moreover, two optional hands-free car installation kits or a simple cradle are available. Other optional accessories include a voice dialer, automobile power adapter and a booster unit.

New product highlights include the Nokia 2100 series of digital hand portables, built for all major digital standards, including GSM, TSMA, Japanese Digital and DCS. Also the Nokia 232, designed for the analog standard is the lightest and smallest phone Nokia has ever made.

Complementing the phone product launches, Nokia Mobile Phones introduced the Cellular Data Card for data communications with digital mobile telephones.

The group's net sales totalled \$1,000 million for the first four months of 1994. Net sales grew 33 per cent over the same period last year. The increase in net sales is primarily attributable to strong sales growth in Nokia Telecommunications and Nokia Mobile Phones, which recorded net sales increases of 56 per cent and 45 per cent respectively.

#### Quality Services Put Asia Paging Ahead of Field 40100096F Beijing CHINA DAILY in English 1 Sep 94 p 9

[FBIS Transcribed Text] Pager communication is becoming an important feature of a modern society.

People exchange information, ideas and news through their pagers. In the business sector, of course, a pager is a must.

The competition among paging companies is keen. The demand is high and customers are demanding. Paging companies have to provide outstanding services to their clients in order to maintain a competitive edge.

Asia Paging is determined to excel in the field.

Asia Paging, which is closely related to Guangdong Mobile Communications Corporation under the administration of Guangdong Post and Telecommunication Bureau, is using a linked tri-area paging network under a single frequency to provide roaming services over three regions including Hong Kong, Macao and Guangdong Province.

The network was launched in April 1993 after three years of planning and is running about 6,000 accounts at present.

Asia Paging operates via its subsidiary, Hi-Q Telecom Co. Ltd., which mainly offers technical support to various paging units.

Hi-Q's business is diversified, ranging from the provision of paging equipment and technical know-how, financial support, training of paging staff and sales of paging systems to helping relevant paging units set up various kinds of paging stations such as auto-paging and operator-assisted paging.

Hi-Q has so far helped to set up more than 100 paging stations. The company's sales package combines its own software programme combined with imported hardware.

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Its sales volume hit \$1 billion in the year to March 1994, a three-fold increase over the previous fiscal year.

In China, Hi-Q's business covers nearly the whole mainland, including Shanghai, Beijing, Guangdong, and Heilongjiang provinces, Shenyang, Harbin and many other cities.

Concerning the paging market in China, "at present, the only way to do so is to invest or co-operate with a local Chinese company, for example, to provide technical support, rent paging equipment or sell a paging system like the Hi-Q," said Asia Paging assistant general manager Jenny Ng said.

The paging market in China still has a long way to develop.

"It is understandable that in this early stage of paging development, the Chinese government must protect its local companies and market. I believe that China will open the market for foreign companies later so as to import technical information from the West. Keen competition will also speed up the growth of the market," Ng said.

"Foreign products are not very suitable for the mainland market and users, so trading business or sales of packages is not a wise choice for long-term business. What we have to do is develop our own technology and products to serve China's demand. A cost-effective product which produces high business turnover is our preference."

Due to the fact that foreign companies cannot run paging businesses directly in China, they must seek Chinese partners to form joint ventures. Nearly 70 contracts for such ventures have been signed.

Asia Paging is confident of consolidating its market share because its network is one of the largest and it offers a variety of paging and other services including secretarial and operator-assisted services.

#### **Champion Plans To Expand Paging Network Worldwide**

40100096G Beijing CHINA DAILY in English 1 Sep 94  
p 9

[FBIS Transcribed Text] At 5:49 pm Moscow time on July 5, 1994, the first message in the Cyrillic alphabet flashed onto the screens of Kantone pagers in the Russian capital. That milestone in the history of radio messaging also represented the beginning of a new era of telecommunications in Moscow.

For Champion Technology, the company behind the Kantone multi-lingual pager and the main partner in the joint venture operating Moscow's first paging service, it was a great triumph. The first message in Cyrillic was the successful conclusion of a race started seven months earlier.

In January 1994, Champion Technology acquired a 100 per cent stake in Multitone Electronics, a British radio message receiver developer and producer with a wide range of advanced products and long experience.

With the Kantone technology and the extra resources brought about by the acquisition of Multitone, Champion Technology could offer a paging service for Moscow in record time.

The joint venture with Russian and American partners, named Multi-Page, received its licence in December 1993, and with the help of Multitone's engineers and Champion's Kantone technology, a combined Cyrillic and English paging service was up and running only seven months later.

The launch of Multi-Page is not only the first test of a successful merger, it is also a stepping stone to provide paging services for other areas in the Commonwealth of Independent States. "The Multitone acquisition has enhanced our group's overall capability and diversified our customer offerings. We have pioneered paging services in the Cyrillic script," Champion Technology Group managing director James Carter said.

#### **Vertical integration: the secret success**

Champion Technology Holdings has grown from a company with HK\$10 million capital and 10 computer programmers in 1987 to one with market capitalization of HK\$4 billion and a staff of more than 2,600. For the 1993 financial year, net profits increased 75 per cent to HK\$140 million. "With no debt, Champion today is a well-capitalized company that is favourably positioned to pursue further expansion and the many exciting opportunities that the future holds," said Paul Kan Man-lok, chairman of the board, president and chief executive officer of Champion Technology.

Champion has no doubts on the secret of its successes. "We are unique in that we are a completely vertically integrated company," said Alfred Li, vice-president, group marketing and sales.

That means Champion is involved in every link in the chain that makes a paging network system.

#### **Champion**

- develops and produces its own pagers (Kantone was the world's first multi-lingual pager) and radio transmitters;
- develops and owns the software needed to run the message networks;
- designs network systems;
- installs paging networks, services and trains staff;
- holds operating licences and operates paging networks on its own.

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Vertical integration can be summed up in three words: control, flexibility and speed.

For customers, this means that Champion can deliver turnkey paging services tailored to the needs of each user in record time. By controlling the source code of all essential software, Champion can service a customer's system effectively, make on-the-spot adaptations and upgrade the system to ensure that it always stays in line with the latest technological developments.

Tailoring a system to the customer's needs not only means that the system works the way the customer wants it to, but also that the customer does not have to pay for a large number of redundant features included in standardized systems.

The operation of its own paging services also functions as a continuous applied research and development programme by giving Champion a first-hand experience in the many problems and needs that may appear in the running of such a high-technology niche as radio messaging.

By acquiring Multitone, Champion has not only increased its capacity, it has also broadened the range of products the group offers. And by merging the technological know-how of its two research departments, Champion has improved its efforts to advance paging technology.

Champion Technology focuses its efforts in three areas: paging, radio-telephony and data communications, and satellite-based services.

The Champion success started with a technological breakthrough: in 1988, Champion's engineers produced Kantone, the world's first multi-lingual pager. That opened up giant markets all over Asia and the Arab world, where an array of non-Roman scripts dominate. Although Kantone's initial success was in China, Champion is quick to point out that Kantone can operate in any script, from Hindi and Urdu to Thai and Cyrillic. Champion's teams of engineers, software programmers and language specialists ensure that the software needed is created and installed as an integral part of the paging network.

The wireless-based radio system covers a transmission region 30 kilometres in radius. The paging units retail in China for \$400, and subscription costs are substantially lower than telephone services. This has led to a great demand, especially in the big cities, where sophisticated products are much sought after.

The fourth generation Kantone multi-lingual message receiver not only handles personal message-receiving, but also provides access to a full range of broadcast information on stocks, currencies and bullion, as well as news and weather reports.

Champion now also offers cross-border paging for subscribers travelling in Guangzhou and Hong Kong. The

ultra-compact fifth generation pager, now in the final stages of development, will boast a four-line capacity and an improved battery life.

#### Investment

Champion has become the first foreign firm to invest in a domestic cellular network on China's mainland. In April 1993, Champion launched a joint venture project to establish an advanced digital cellular radio system in Chengdu, where the group has already installed a paging system.

The joint venture company, Champion Tongfa Telecommunications Co. Ltd., will be the world's first to apply Extended Time Division Multiple Access technology.

In January 1993, Champion entered into an exclusive agreement with the US-based Orbital Communications Corp. (Orbcomm) to introduce two-way messaging services via Low Earth Orbit Satellites (Leosat) in China. This system is particularly appropriate for the China market, because it permits light data transmission over vast areas, without requiring the installation of thousands of tower-mounted radio transmitters.

Champion, in conjunction with several Chinese partners, plans to install a control centre for the Orbcomm system and gateway stations as early as 1995.

Champion plans to integrate Leosat messaging with its paging network and will introduce two-way Chinese language messaging and information services. By the end of 1995, when all of the 26 Leosats are deployed, Orbcomm services will begin to be made available internationally. Champion has exclusive rights for developing Orbcomm services in China.

#### Philips Targets China's Growing Telecom Industry

40100096H Beijing CHINA DAILY in English 1 Sep 94 p 10

[FBIS Transcribed Text] People using pagers and mobile phones are a common sight in a modern city like ours.

Instant communication devices have changed the fabric of society and created a new way of life. Pagers and mobile phones introduce mobility and speed of communication which strikingly affect human relations.

Companies involved in the industry are playing an increasingly important role in society.

Philips, a famous worldwide electronics company, is active in the telecom market. Its services include pagers, PABX, personal communication devices, radio transmission, smart cards—which are electronic cards for identification, credit and security purposes—data networks for banking application and private usage as well as various transmission products.

Philips is devoted to exploring communication systems in China.

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"We have been active in China for a number of years in the communications industry, having established technology transfer of PABX and rural telephone products," said Mark Leigh, general manager of Philips' Communication Systems Division.

"Today, we offer a wide range of products from paging, cellular phones and smart cards to trunked radio networks and transmission products for both public and private use."

One of the highlights of Philips' new telecom products is the PRG 2320 Chinese Character Pager.

"It is a versatile pager with a unique large LCD screen which is capable of displaying 4 lines of text. The LCD screen features 10 characters per line; automatic back-light and optical sensor technology, while the message capability features 99 personal memories, 50 personal data storage memories, 48 mailboxes of each containing 60 characters," said Steven Weeks, marketing manager of Philips' Communication Systems Division.

Moreover, five user alarms are provided and permanent back-up of data storage memory and message protection or deletion are available.

Other features are suppression of duplicate call, optical interface and priority for urgent calls. With these merits, the PRG 2320 is gaining wide support.

"Philips has launched this new model in China in August, having set up six service stations in China and a further service centre is planned in Nanning. These centres are responsible for testing and repairing products and training of staff," Leigh said. By the end of 1994, Philips also hopes to introduce bilingual display pager.

PRG 2130 Mini Numeric 30 Pager is another new product of Philips with stylish characteristics.

The LCD screen features an optical sensor, automatic back lighting and automatic light sensor. The message capability features 20 characters per message and the storage of 30 messages.

Moreover, all messages are logged with time stamp and users can select or protect messages. Messages can be numeric or alpha.

"In fact, PRG 2320 and PRG 2130 are quite similar in terms of features as they share the same ultimate technology. The two models are using POCSAG (APOC) Advanced Paging Operators Code which is the latest paging system code developed by Philips to transmit information. This code is an advanced version of POCSAG which was also developed in conjunction with Philips in 1978. It can increase users per radio channel, battery life and call success," Weeks said.

"What is more, this code is 100 per cent compatible with POCSAG reducing network costs. Therefore, APOC effectively reduces the operating costs which will in turn benefit the pager user."

The PR 93 hand-held mobile phone is another of Philips latest products.

"It is a small and light phone with a 24-digit, two-line display and 12 extra symbols to present everything you need to know about reception quality, length and cost of call, state of battery etc.," said Tony Chan, marketing manager of Philips' Communication Systems Division.

"Once mounted in the car kit, the battery is recharged and hands-free operation is available."

PR 747 is a digital cellular phone featuring a light lithium battery which makes the phone weigh less than 200 grams. This weight and the small travel charger make it possible to have the phone always with you.

It can be connected to a portable computer or fax, serving to send or receive data and text messages. There are several levels of security functions operated by different numeric codes to prevent unauthorized access to the phone.

Five different ringing tones at various volumes, 10 different display languages and extensive storage functions are also available.

Preparations are under way for the launch of these two sophisticated mobile phones. Sales are expected to be promising.

Today, instant communication systems are beginning to dominate world communications. This trend will inevitably lead to a greater demand for products from leading manufacturers such as Philips.

#### **NEC Expands Business To Cash In on Market Potential**

401000961 Beijing CHINA DAILY in English 1 Sep 94  
p 10

[FBIS Transcribed Text] Companies selling personal communication devices are all eager to explore the Chinese market.

The potential is great due to its huge population. As China is becoming more and more open, especially the business sector, pagers, mobile phones and personal computers are playing an increasingly important role. Many business dealings and even daily conversations are nowadays carried out using a pager.

The NEC group is leaving no stone unturned in China's mainland. In fact, two NEC companies are in charge of its business in the PRC. One is the NEC Hong Kong Ltd. headed by S. Yoshimura; the other is NEC Japan.

NEC HK is responsible for sales of marketing-oriented products such as the PABX, pager, HHP, PC, printer, monitor, disk drive and mobile phone, while the NEC Japan is setting up infrastructure products and systems such as central switch.

"We are selling communication computer products in the PRC. We are confident of the quality of all products and we believe that our users are satisfied. We have to provide high-quality and sophisticated products in the PRC just like in other countries. Our pager market share is more than 20 per cent and we are one of the top suppliers in China," Yoshimura said. NEC's sales for the past 12 months rose more than 100 per cent over the previous year.

Despite the austerity programme and tight control of the economy by the government, the business field is essential for the economy and society. Therefore, NEC expects sales will increase more than 60 per cent next year.

The company has four representative offices in Beijing, Shanghai, Guangzhou and Shenzhen. These offices are responsible for liaising for NEC HK on various business matters.

For maintenance services, NEC HK appoints authorized dealers to provide services to its customers.

The company has established two joint ventures in the PRC. One is TCL Mobile Communication Equipment Ltd. in Huizhou, Guangdong Province. It is a joint venture producing pagers between NEC NK, TCL Communication Equipment Share Company Ltd. and Hing Tat Investment Ltd.

The other joint venture is Wuhan NEC Zong Yuan Mobile Communications Company Ltd. in Wuhan, Hubei Province. It is a joint venture producing handheld phones between NEC HK, China National Zongyuan Factory and Yangtze Industry Group of Optical Fibre Communications.

NEC's customers include government organizations, home users and individuals.

NEC supplies printers to the British Government in Hong Kong and its PABX is the best seller in the hotel market in Hong Kong.

"In the coming three years, we believe the PRC market will keep on growing and we are planning to expand our business by putting more resources into the market. Our products are reliable and we always make use of advanced technologies. This is proven by the fact that we are ranked within the top seven largest sales companies in the world in all three major electronics fields including information technology (No. 3), telecommunications equipment (No. 7) and semiconductors (No. 2)," Yoshimura said.

Explaining NEC's success in China, Yoshimura said: "It is simple. We have been making a commitment to China for a decade and our basic stance is to realize our company's philosophy that NEC strives to help advanced societies worldwide deepen mutual understanding and fulfill human potential. Our long-term

commitment to the PRC together with our brand image and good service will surely lead us to success."

#### Taihua Markets Miniature Paging System

94P60382A Beijing ZHONGGUO DIANZI BAO  
[CHINA ELECTRONICS NEWS] in Chinese  
22 Aug 94 p 3

[Article by Bao Xin [0545 2500] and Xiao Jing [2556 0079]: Taihua's Miniature Paging System On Market]

[FBIS Summary] The low-priced miniature paging system recently designed by the Beijing Taihua [3141 5478] New Technologies Company is now on the market. Intended for users in small-to-medium-sized towns and for managers and officials in industry, government, and the military, this miniature paging system is numeral/Chinese-character/English-alphabet compatible and is easily expandable from the basic capacity (500 users) up to 3000 users.

#### East China Building Radio Paging System

94P60382B Beijing ZHONGGUO DIANZI BAO  
[CHINA ELECTRONICS NEWS] in Chinese  
22 Aug 94 p 3

[Article by Liu Dong [0491 2639]: "Radio Paging Network for 13 East China Cities to be Operational by Year's End"]

[FBIS Summary] It has been learned from MPT sources that the public radio paging system being built by 13 East China cities—in Jiangsu Province, Zhejiang Province, Shandong Province, and Shanghai Municipality—will be on line by the end of this year. This agile, high-efficiency paging network will unite radio paging equipment presently in a variety of styles and communications formats.

#### Mobile Equipment Production Line Operational

94P60382C Beijing ZHONGGUO DIANZI BAO  
[CHINA ELECTRONICS NEWS] in Chinese  
22 Aug 94 p 3

[Article by Wei Guangdong [7279 1639 2767]: "Plant 759's Mobile Communications Equipment Production Line Formally Operational"]

[FBIS Summary] A mobile communications equipment production line using the SMT system is now formally operational at State-run Plant 759 in Chongqing. The first batch of almost 4000 EK-2076 beepers has passed quality check, with all technical indicators meeting design standards. The production line, using the SMT system made by Japan's TESCON Company and imported in 1992, includes two FA-301 chip-type component assemblers, one FA-MEC-4000 manual silk screen printer, one FA-KLU-50-250 infrared-ray reflux oven, and Point 4055 4-head, 8-tip on-line testers. The production line is also equipped with a crest solderer made by Sweden's Kirsten Company.

### **Guangdong Completes Nation's First 622 Mbps SDH Fiber Optic System**

94P60382D Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 3 Sep 94 p 1

[Unattributed article: "Information Highway Construction in Guangdong Commences"]

[FBIS Summary] The nation's first multichannel synchronous digital hierarchy (SDH) 622 [Mbps, STM-4 standard] fiber optic communications system was recently completed by the Guangdong Province P&T Office. This fiber optic SDH system, based on imported high technology, runs 540 km from Guangzhou to Shantou, and will provide over 41,000 new long-distance circuits between Guangzhou and eastern Guangdong.

### **Zou Jiahua Addresses Meeting on Information Highway**

0W1509013794 Beijing XINHUA Domestic Service in Chinese 1252 GMT 12 Sep 94

[Article by Zou Qingli [6760 3237 7787]]

[FBIS Translated Text] Beijing, 12 Sep (XINHUA)—A joint conference on bringing the national economy into the information age was held at the Great Hall of the People today to coincide with the 10th anniversary of the release of Comrade Deng Xiaoping's inscription: "Develop information resources to serve the four modernizations." At today's conference, Beijing, Shanghai, Tianjin, Liaoning, and 20 other provinces and municipalities signed agreements with Jitong Corporation and the State Information Center on jointly starting the Golden Bridge project.

Zou Jiahua, Vice-Premier of the State Council and chairman of the conference, spoke. He said: The inscription, which was written by Comrade Deng Xiaoping 10 years ago in a display of foresight, pointed the way in which China's information industry would develop. Over the past 10 years, China has set up a dozen or so large application-specific computer systems, more than 100 information networks, and over 800 databases. There are now over 60,000 assorted information service organizations and enterprises in China, employing over 1 million people, and selling more than 8 billion yuan worth of products.

Zou Jiahua said: China's economy is still in a stage of development marked by high consumption of energy and raw materials, poor efficiency, and extensive management. Energy and raw materials consumption for each unit of GNP is three to five times the amount for developed countries, while overall labor productivity is only 5 percent that of developed countries. Hastening the process of bringing the national economy into an information age can significantly improve the rate of utilizing resources, increase the output value added in

each stage of production, and improve labor productivity. Therefore, we should continue to carry out Comrade Deng Xiaoping's instruction and devote great efforts to bringing the national economy into the information age.

Zou Jiahua said: The Golden Bridge project is the basic project to bring the national economy into the information age, as well as a public and key component of the national information network. It is a network linking the sky with the ground, serving as a single network management system under which satellites in the sky interact with ground-based fiber optic networks. Starting out as a "medium-speed information highway," it will evolve into an "information superhighway" in the future. The Golden Bridge network is intended to serve the needs of the state's macroeconomic regulation and control, and to pave the way for the joint utilization of information and the development of an electronic information market. He maintained that the Golden Bridge project got off to a very good start because the joint conference on bringing the national economy into the information age supported the practice of using state economic information systems to set up the first group of information stations to be linked up by networks in 24 provinces and municipalities.

In light of China's vast territory and underdeveloped communications infrastructure, Zou Jiahua called for employing all communications means in building the Golden Bridge project; making overall plans; overcoming the tendency to launch widely scattered or overlapping projects; paying attention to standardization, education, and legislation; and taking relevant measures to protect confidential information on hardware and software.

### **Calls Start on High-Tech Phone Line**

40100101A Beijing CHINA DAILY in English 16 Sep 94 p 2

[Article by Li Wen: "Calls Start on High-Tech Phone Line"]

[FBIS Transcribed Text] Guangzhou—China's first SDH transmission trunk line, the basis of the construction of a national information superhighway, officially went into operation yesterday in South China's Guangdong Province.

The world's most advanced optical-fibre SDH (synchronous digital hierarchy) line, between the capital Guangzhou and Shantou in eastern Guangdong, was supplied by Siemens AG, the world's electronics and telecommunications giant.

The 530-kilometre-long line, called a SDH 622 MB/s system, will help ease the communications shortage in eastern Guangdong and meet the booming economy's



demand for advanced communication services, Guangdong Posts and Telecommunications Administrative Bureau Director Luan Zhengxi said.

The project will double the region's long-distance communications capacity by adding 42,000 new lines. Through the SDH service, 40,000 telephones will be able to operate at the same time.

Guangzhou Nanfang Transmission Systems Co (GNTS), Siemens' only joint-venture in Guangdong, was responsible for the project's design, installation and technical supervision.

GNTS general manager Kai Kuan said the project is the first of the company's many expansion plans.

"We are planning to invest \$10 million next year on the production of SDH products in Guangzhou," he said. His joint-venture was founded one year ago with an initial investment of \$10 million.

By the end of this year, two other SDH linkages between Huizhou-Shenzhen and Guangzhou-Zhuhai-Macao will be connected by GNTS.

Bernd Schumacher, who is in charge of Siemens' public communication networks in China, said the German-based company will become the major player in China's transmission market by providing the SDH equipment and know-how.

#### Global Computer Network Set Up

40100101B Beijing CHINA DAILY (BUSINESS WEEKLY) in English 16 Sep 94 p 5

[Article by Shao Ning: "Global Computer Network Set Up"]

[FBIS Transcribed Text] What's a million times smaller than an atom and leads top Chinese scientists into the computer net world? A tau lepton.

Although most people have no idea what this is, scientists swear it is vital to the research of high energy physics.

And this measurement of tau-mass, by using the Beijing Electron-Positron Collider (BEPC), paved the way for Internet, the world's largest computer network to be connected with China.

Internet, which was developed 25 years ago by the US Defence Department for scientific research and resource sharing, has opened to Chinese science society.

today, Internet links more than 400 top Chinese scientists with nearly 25 million computer users worldwide. It provides them with access to large amounts of information that's processed daily through nearly all the super computers of the big labs in the world.

"They are now able to send messages, publish papers, prepare for conferences and exchange ideas with their

foreign colleagues in a faster and more reliable way," said Dr Xu Rongsheng, head of Institute of High Energy Physics (IHEP) Computing Centre.

Meanwhile, Internet has drawn Chinese scientists closer to their colleagues and brought China closer to the world.

In an Email a Chinese student studying in a US university said that she was surprised to find a "China Home Page" in a new Internet software programme called World Wide Web (WWW). She said she felt closer to home and it helped ease her feelings of homesickness.

The first batch of the Chinese Internet users were IHEP scientists, who have been co-operating with their foreign colleagues on research of high energy physics.

The collider was developed at IHEP in 1988. Soon, IHEP gained an international reputation in the field of high energy physics for its collider experiments and research. This opened the BEPC for collaboration between Chinese physicists and their colleagues worldwide.

In that year, IHEP officially linked itself to the Centre of Europe on Research of Nuclear (CERN) via a 4.8k bps (bit per second) line.

The BEPC facility proved to be very alluring. In August 1991, Chinese and American scientists opened their collaboration programme at IHEP on Tau-mass measurement, a very important experiment in high energy physics.

Over 20 U.S. physicists joined the programme. The experiment ended in February, 1992 and the result, announced two months later, showed a five times higher precision measurement than before.

During the joint research, both Chinese and American physicists found they needed a more powerful communication tool to simultaneously conduct their research on separate continents.

Internet proved to be the most economical and efficient tool.

As soon as Sino-US high energy physics co-operation began, American physicists suggested to link the computer in IHEP to the United States. In October, 1991, an agreement on the link was signed at the annual Conference on Sino-US High Energy Physics Research.

At the same time, with the technical help of AT&T, IHEP and Beijing Telephone Administration (BTA) formed a research group to build the 64k bps line from IHEP to AT&T satellite. BTA opened a special optical fiber line for this computer network while IHEP allocated \$8,000 a month for the rent of AT&T satellites.

The advantage of this union was immediately apparent.

The link made it possible for Chinese physicists to use US supercomputers to manage urgent data from BEPC. Meanwhile, US physicists don't need to wait a week for

experiment data to arrive via international post. If they want, "today's" data is available immediately from Beijing.

When the Tau-mass measurement experiment was at its crucial stage and through completion, Chinese and US physicists exchanged their ideas, drafts of the theme and did their data analysis frequently through the network.

The final theme corrected old data that had been in use for more than 12 years. When the result was released to the World High Energy Physics Society via Internet, the physicist community immediately applauded the co-operation.

In March, 1993, Chinese and American physicists started a new physics experiment collaboration. This co-op project fostered the link between IHEP and Stanford Linear Accelerator Centre (SLAC) in California in the United States. Via AT&T satellite, both American and Chinese scientists were able to send a whole page story directly to the US in about 5 seconds through leased line in China.

The connection allowed IHEP Computing Centre to work as a user of the SLAC supercomputer and gave it partial access to the functions of Internet.

Meanwhile, IHEP Computing Centre devoted itself to enhancing the functions of the computers.

In May, 1994, when the US Government opened its Internet totally to China, the IHEP computer node became the first node in China that has access to full operation of the Internet. It was upgraded to the same level user as SLAC.

Although the data is being transmitted through a 64k bits per second line—the slowest today within the Internet—IHEP has benefited a lot from it and wisely opened its network resources to the whole Chinese science society.

In 1993, with the support from the National Science Foundation of China (NSFC), IHEP began to help some of the top Chinese scientists and professors to set up Email addresses in the computing centre for world-wide academic communications.

Some institutes also directly connected their Local Area Network to the IHEP network.

Now the IHEP Computing Centre has opened accounts for more than 400 Chinese top scientists in different research areas so that they can exchange Email with the outside world and obtain pre-prints.

Those scientists can work at the office or even at home using a modem through the phone line. Fifteen phone lines are available for them to remote log in from Beijing and other cities to IHEP Internet nodes to connect all over the world.

Users find the net is a fast, cheap and reliable way to communicate overseas. Investigation shows most of the 400 users log in to the IHEP node everyday.

Since it is possible to install softwares from the network, users of IHEP have been able to use all the popular softwares in Internet, including World Wide Web, gopher and telnet.

However, one user felt information retrieval should be changed because the information in Internet includes not only documents, but also photos, video and sounds.

Some users also have their accounts in overseas computers. A user in Beijing Observation said that he can easily log in to U.S. computers through the IHEP node. Thus he can even 'talk' to others in the U.S. by using his keyboard and in the meantime, IHEP continues to set up its scientific information database for physicists all over the world.

WWW, the new software for the Internet, is a world-wide information searching system. IHEP node installed it recently and linked its own database to it. It's the first free Chinese database that all the users of Internet can see.

IHEP computing centre included a special page called "China Home Page" to introduce China to the world. In that page, people can find basic introductions to Chinese cities, universities and user names of the IHEP node.

On a map of Internet lines only a thin road links Beijing to the information highway spreading throughout America, Europe and Asia. The rest of China is still blank.

As the first node in China, IHEP continues to develop its centre and wants to maintain its leadership role.

According to Dr Xu, IHEP transferred its IHEP-SLAC network link to IHEP-KEK (Japanese National Institute of High Energy Physics in Tsukuba near Tokyo) in July via International Telecommunication Japan 64k bps satellite channel. A fibre optic line from Shanghai to KEK completed earlier this year allows IHEP to upgrade the link rate to 128k bytes per seconds or more and to establish video conference on the Internet.

"China must have its own information highway sooner or later, because it's such an important basic installation for a country, just like the telephone," said Xu.

"Now we want all the scientists to use it. The IHEP computing centre will continuously devote itself to developing techniques for more powerful communication and help to others."

#### Provinces Linked by Network

40100101C Beijing CHINA DAILY (BUSINESS WEEKLY) in English 19 Sep 94 p 8

[Article by Lu Honggang: "Provinces Linked by Network"]

[FBS Transcribed Text] Video conferences are taking root in China following the recent establishment of a network linking Beijing to each of the provincial capitals.

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The Ministry of Posts and Telecommunications (MPT) has just finished building the first stage of the national phone-video web, known as the Dedicated Digital Network (DDN).

With a DDN system, officials can attend national conferences in their home provinces without travelling to Beijing.

Premier Li Peng inaugurated the system when he convened a price control conference with about 1.8 million local cadres on 6 September.

Network construction within some provinces is under way to extend video conferences to county towns. The first stage of investment already cost 90 million yuan (\$10.5 million), which does not include overhead for conference facilities and cables.

With the national network already in place, MPT will kick off the second phase of construction next year, installing pivotal relay stations in major cities, said Li Zhengzhong, a senior engineer from the Beijing Radio Telecom Bureau.

With servers, or Multi-control Units (MCU), installed in each pivotal station, a conference chair in Beijing will be able to rally local officials. Then provinces could get in touch with each other through their branch hubs without using the Beijing DDN line.

Expertise and equipment for the national DDN system came from the California-based Compression Labs Incorporated (CLI), a leader of compressed digital video (CDV) technology.

The traditional way to transmit video signals with analog technology costs too much as it needs hundreds of telephone lines for one transmission, said CLI's Asian Pacific Managing Director Raymond C. Hsu.

Hsu said CDV technology offers to save bandwidth, thereby cutting transmission costs. For example, if an analog transmission signal demands 960 lines, another compressed and digital signal needs only 30.

Problems, however, are still lurking. The ministry's biggest concern is compatibility between networks of different provinces.

As they joined the rush to install the new system, provinces chose a variety of brands. CDV makers differ in technology, which poses a serious question of MCU compatibility.

Global experts are struggling to come up with an international standard, but have yet to agree on one. This affects CDV business in China, which will be quite clear by December when the Ministry of Railways will award franchises to connect its 12 regional bureaux.

Major CDV producers—Britain's GPT, France's SAT and CLI and Picturatel from the United States—will vie for the bids.

"We hold out fair chances," said Qiu Zhenbang, director of the DDN office. "Whoever turns their MCU technology into ITU standards seizes the market."

#### 10-Channel WDM+EDFA Experimental All-Optical Communications System

94P60356A Beijing GAO JISHU TONGXUN [HIGH TECHNOLOGY LETTERS] in Chinese Vol 4 No 7, Jul 94 pp 1-3

[Article by Xu Anshi [1776 1344 1102], Wu Deming [0702 1795 2494] et al. of the State Key Laboratory for Local Area Fiber Optic Communications Networks & Coherent Fiber Optic Communications, Dept. of Radio & Electronics, Beijing University, Beijing 100871: "10-Channel Wavelength-Division-Multiplexing + Erbium-Doped Fiber Optical Amplifier All-Optical Communications Experimental System," supported by grant from 863 Program; MS received 28 Mar 94]

[FBIS Abstract] The first domestic 10-channel, 102-km-unregenerated WDM+EDFA (wavelength-division-multiplexing + erbium-doped fiber optical amplifier) experimental all-optical-fiber transmission system using one EDFA is reported. The 10 channels have the following frequencies: 1531 nm, 1535 nm, 1537 nm, 1545 nm, 1547 nm, 1549 nm, two at 1551 nm (with a 2-channel FDM system to combine them), 1559 nm, and 1561 nm. The total length of the system is split into two segments: the first 49 km and the second 53 km, with the EDFA placed between the segments. Transmission rate for each channel is 140 Mbps or 280 Mbps, with NRZ/PRBS [non-return-to-zero, pseudo-random binary sequence] encoding. The flat-gain EDFA (type OP-980-F-15, made by Italy's Pirelli Co.), at an input power of -3 dBm [decibels referenced to 1 milliwatt] and at a wavelength of 1550 nm, has a saturated output power of +15 dBm, a small-signal gain of about 35 dB, a pass-band width of 1530-1560 nm, and a noise figure under 4 dB. Throughout, the system employs domestically made DFB [distributed feedback] laser diodes and conventional, single-mode fiber with an average loss of about 0.3 dB/km. At the receiver end, in addition to a 3-circuit APD+FET [avalanche photodiode+field-effect transistor] transresistance preamplifier, there are several PIN-FET [positive-intrinsic-negative FET] IC modules. After unregenerated transmission over the entire 102 km length, with a bit error rate of  $1 \times 10^{-9}$ , the measured power reserve was several dB (maximum 12).

Figures 1-4, not reproduced, show a schematic of the experimental system, a spectrum of the transmitted information at the input end of the fiber, a spectrum of the transmitted information at the WDM input, and a photograph of the eye charts transmitted over the 1535 nm channel. There are no tables.

#### References:

1. Li, T.Y., PROC. OF THE IEEE, 1993,81:1568.

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2. Wang Zixiong, Xu Anshi, Xie Linzhen, GAO JISHU TONGXUN [HIGH TECHNOLOGY LETTERS], 1992,2(8):4.

3. Wang Zixiong, Xu Anshi, et al., GAO JISHU TONGXUN, 1992,2(12):6.

**Federation of Economic Organizations To Support China's Fiber-Optic Communications Network Project**

94P60370A Tokyo DEMPA SHIMBUN in Japanese  
4 Aug 94 p 2

[FBIS Translated Text]

The Federation of Economic Organizations (Keidanren) plans to propose an economic cooperation plan entitled "The Silk Road 21 Initiative" which mainly involves establishment of a fiber-optic communications network between East Asia and Turkey and energy development. It is part of the comprehensive development program for China and central Asian countries, which the State Science and Technology Commission of China is planning.

If a substantial portion of the proposed initiative is accepted by the Chinese program, Keidanren intends to ask the Japanese government to cooperate as well as part of the national project. It is estimated to be a giant project costing several trillion dollars (several hundred trillion yen). Keidanren hopes that it will "not only bring in Japanese companies to participate but also will be a significant means of recycling Japan's surplus."

The "Silkroad 21 Initiative" will be proposed at a four-day International Conference to be held in Beijing starting on 15 November. Keidanren as well as the European Union (EU) and U.S. companies have been invited to attend the Conference.

Keidanren's initiative focuses on:

- 1) establishment of social infrastructure for East and West exchange;
- 2) promotion of a market economy;
- 3) industrial development;
- 4) measures to protect the environment.

The establishment of infrastructure for the East-West relationship highlights a "Silknet" fiber-optic communications network connecting Japan, Korea, China, central Asian countries, Iran, and Turkey. The plan is to establish information infrastructure by building a silkroad version of the information highway network to link East and West. Also the construction of railway and international airline networks are being proposed to transport personnel and materials.

Proposals to promote the market economy include management technology transfer to develop private companies and construction of business centers. The industrial

development proposal includes development of the mining, oil, gas, and spinning industries. The Central Asian countries, including Turkmenistan, are especially promising in the oil and gas resources, and exports to Japan would be possible if "Silk Pipeline" of approximately 6,000 kilometers were built through the Tarim Basin in China to the East China Sea.

Keidanren in the past has promoted national projects including an Amazon Aluminum Project (Brazil) in order to secure resources. At present, however, Keidanren has no such project, and therefore this new large undertaking is also being strongly supported as a means of reducing Japan's surplus with other countries.

**Physics**

**Test of the Saddle Superconductive Magnet for MHD Generator**

40100091A Beijing DIWEN WULI XUEBAO  
[CHINESE JOURNAL OF LOW TEMPERATURE  
PHYSICS] in Chinese Vol 16 No 3, May 94 p 238

[English abstract of article by Yan Luguang, Lin Liangzheng, Gao Zhiyuan, Wang Zikai, and Jing Bohong, Institute of Electrical Engineering, CAS; and W.B. Zenkevitch, A.S. Veselovski, L.A. Kirienin, and V.P. Baev, High Temperature Institute, Russian Academy of Sciences, Moscow; Manuscript received 25 Nov 93]

[FBIS Translated Text] A saddle superconducting magnet for experimental MHD generator was completed at the Institute of Electrical Engineering, CAS. The magnet has  $\phi$  44cm warm bore, 103cm effective magnetic length and 4 T central field. It consists of 17 layers, each layer having two circular saddle coils with 54.5° segment cross section. The conductor is 2mm x 10mm NbTi monolithic provided by Supercon Inc. The performances and the test results of the saddle superconducting magnet are presented in this paper. The test shows that the magnet ran steadily and reliably with central field of 4.13 T. The saddle magnet meets perfectly the design and application requirements.

**Taiwan: Test Results of INER TR30/15 Compact Cyclotron, Isotope Production Facility**

94FE0543A Chia-An HO-TZU K'O-HSUEH  
[NUCLEAR SCIENCE JOURNAL] in Chinese Vol 31  
No 1, Feb 94 pp 47-57

[Article by G. Ting, P.S. Song, Z.T. Tsai, C.C. Chen, W.H. Wang and Y.C. Tong of the Institute of Nuclear Energy Research, Lung-Tan, P.O. Box 3, Taiwan 325, R.O.C.: "Test Results of INER TR30/15 Compact Cyclotron, Isotope Production Facility," MS received 3 Nov 93, accepted 24 Dec 93]

[FBIS Translated Text]

### Abstract

Construction of the compact cyclotron and isotope production facility at INER started in July 1990 and was completed in July 1993. Functional acceptance tests of the TR30/15 cyclotron were completed on 12 July 1993. The results show that the equipment met its performance specifications. The gas and solid target systems passed acceptance tests on 7 June and 10 June 1993, respectively. A total of 5.2 Ci of I-123, 1.55 Ci of Tl-201, 7.8 Ci of Ga-67 and 6.26 Ci of In-111 were obtained from the targets. Radiation safety and shielding tests show that the cyclotron vault, target station caves and lead cells can effectively meet radiation protection requirements.

### Introduction

Construction of the compact cyclotron and isotope production facility at the Institute of Nuclear Energy Research (INER) started in July 1990 and was completed in July 1993. The principal objective was to build a modern cyclotron and isotope production facility. It is comprised of a TR30/15 cyclotron (H<sup>+</sup>/D<sup>+</sup> 30/15 MeV) made by EBCO in Canada and an I-123 gas target production system, two solid target caves, a non-isotope target cave for applied research, lead cells, and a clean room for nuclear medicine development. The facility is primarily used to produce radioactive isotopes and labels for medical use, including I-123, Tl-201, Ga-67, In-111, Co-57 and F-18. Secondly, it may be used for applied physics, materials science and life science research such as mechanical wear and tear, thin-film activation analysis and neutron photography. The tests were carried out by personnel from the manufacturers (EBCO/TRIUMF and NORDION) and INER.

This test run was a test of the newly completed hardware facility, which was completed in accordance with INER's "compact cyclotron and isotope production facility construction plan."<sup>(1)</sup>

The results include: (1) performance of the TR30/15 compact cyclotron and its gas and solid target caves and hot run results and (2) radiation safety and shielding results of the cyclotron, target caves and hot lead cells. The operating and safety procedures of this test run were prepared with reference to safety technical reports published by foreign manufacturers<sup>(2-10)</sup> and the "test plan for the cyclotron and isotope production facility"<sup>(11)</sup> approved by the Atomic Energy Commission (AEC). The contents and results of the test run are presented in this paper.

### Cyclotron System Test and Results

According to the specifications of the compact cyclotron and beam transmission system (TR30/15 H<sup>+</sup>/D<sup>+</sup>, 30 MeV/15 MeV, 350  $\mu$ A/150  $\mu$ A), there are eight items to be tested:

#### 1. Energy range

The energy output of the cyclotron was tested. It should be 15-30 MeV for H<sup>+</sup> and 8-15 MeV for D<sup>+</sup>.

#### 2. Current range

The current output of the cyclotron should have a maximum of 350  $\mu$ A and a minimum of 10 nA for H<sup>+</sup> particles. When both beams are on, the total current is 400  $\mu$ A. The maximum current for D<sup>+</sup> beam alone is 150  $\mu$ A.

#### 3. Simultaneous output in two directions

The performance characteristics with output in two directions were tested in different combinations of equal energy levels, equal and different currents and energy levels, and equal and different currents.

#### 4. Beam size

The beam size should be varied between 0.5 cm and 3 cm.

#### 5. Vacuum capability

The cyclotron should reach a steady beam current of 350  $\mu$ A after 6 hours of operation at 1 atm and another 6 hours of pumping.

#### 6. Energy dispersion

Thin-film, large-angle energy dispersion measurements were made to determine its energy dispersion.

#### 7. Deuteron/proton conversion

After operating a deuteron beam for 2 hours, the target can be irradiated with a proton beam.

#### 8. Long-term endurance test

The system was put in operation continuously 24 hours a day for 2 weeks using targets purchased from abroad. During this 2-week period, the beam utilization rate was higher than 90 percent. In addition, the life of the carbon film was tested. In items 1-3, every combination was tested for 1 hour. The transmission efficiency of the cyclotron should be greater than 95 percent, beam loss between the extractor and the target should be less than 5 percent, beam stability should be within plus or minus 5 percent, and beam utilization rate should be higher than 99 percent. All test data are analyzed and the results are summarized in Table 1. Figure 1 [photograph not reproduced] shows a picture of the TR30/15 cyclotron. Figure 2 shows the layout of the cyclotron chamber and target cells.

**Table 1. Test Results of INER's TR30/15 Compact Cyclotron and Isotope Production Facility**

Item	Results
1. Particle-beam quality test	
(Different energy/current/beam combinations)	(Mean value)
(a) Beam transmission loss	3.85%
(b) Beam acceleration loss	3.80%
(c) Beam stability	+/- 3.78%
(d) Beam utilization rate	99.2%
2. System vacuum timing test	
(a) Time at 1 atm	6 hours
(b) Time to reach steady beam current at 350 $\mu$ A after pumping begins	5 hours 11 minutes
3. Beam size and energy distribution at target	
(a) Size range	0.5-3.0 cm
(b) Energy distribution	Very uniform
4. Endurance test	
(a) Period of continuous operation	2 weeks
(b) Beam utilization rate	96.52%
(c) Replacement of rotating carbon-film disk	None
5. Deuteron beam	

(a) Beam current	150 $\mu$ A
(b) Deuteron-to-proton-beam switching time	1 hour 18 minutes
6. Proton-beam energy (30 MeV) diffusivity	
(a) Beam energy diffusivity FWHM (full width half maximum)	429.23 KeV

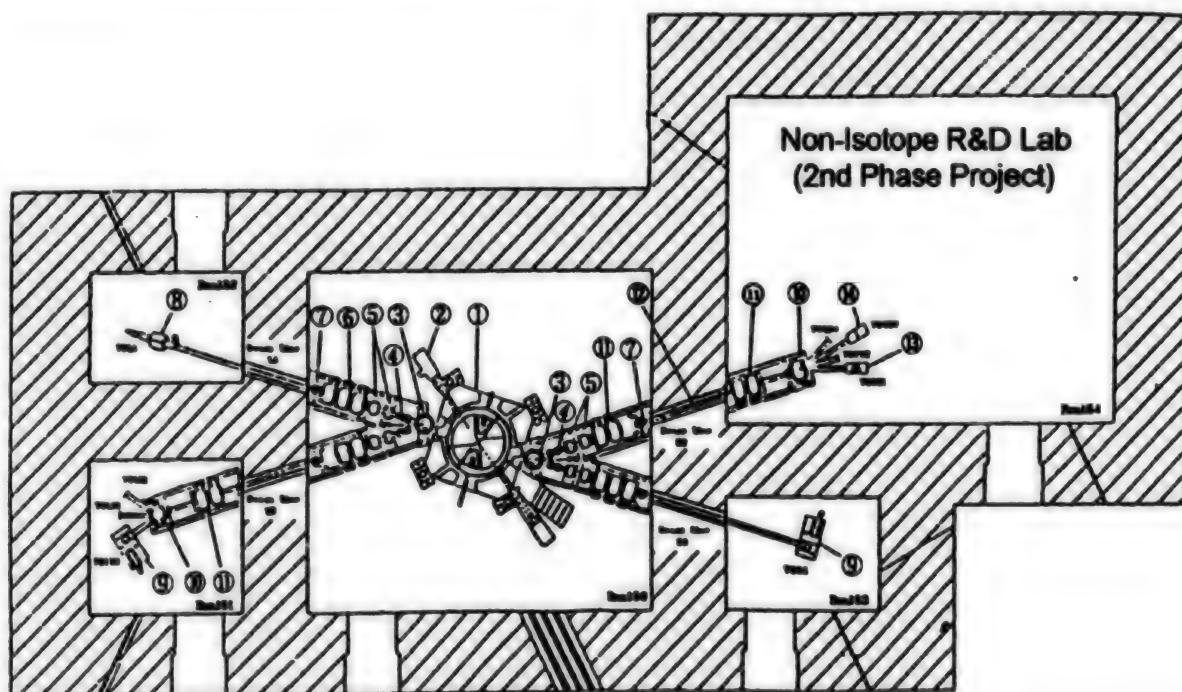
### Gas Target System Test and Results

In addition to the cyclotron, INER also acquired a gas target system that produces I-123 and some development equipment from Nordion Corporation in Canada. Its specifications and test results are listed in the following.

(A) Items to be tested for the gas target system are as follows:

1. Leak test of the gas target system.
2. Transport of Xe-124 gas.
3. Bombardment of the gas target.

During three continuous production runs, the Xe-124 in the gas target was irradiated with a 30 MeV, 120  $\mu$ A proton beam for 2-6 hours. After allowing it to decay for 6 hours in the target cave, characteristics of the iodine isotope produced, such as production efficiency, radiochemical purity, radioactive nuclide and concentration, were measured.



**Figure 2. Layout of the INER Cyclotron and Target Caves**

Key: 1. TR30/15 cyclotron; 2. Extractor; 3. Collimating/deflecting magnet; 4. Refrigeration pump; 5. Tuning magnet; 6. (3) quadrupole focusing magnets; 7. Neutron-beam blocker; 8. Gas target; 9. Solid target; 10. Deflecting magnet; 11. (2) quadrupole focusing magnets; 12. Beam transmission line; 13. Radiation damage research station; 14. Mechanical engineering application research station.

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## 4. Target wash and product separation.

## 5. Product analysis.

Radiochemical purity and nuclide purity of the I-123 produced were analyzed.

## (B) Test Results

## 1. Gas target leakage:

(1) Vacuum test: Starting from 5 mTorr, 14 hours later the pressure was found to be 234 mTorr, which indicated that the hermeticity of the system is excellent.

(2) Pressure test: Starting from 400 KPa, the pressure was found to be 397 KPa after 12 hours, a loss of 3 KPa.

2. Transport of Xe-124: Naturally enriched Xe and Xe-124 gas were transported three times. The vessel was pressurized at 550 KPa before and after bombardment. There is no obvious change.

## 3. Bombardment of gas target:

(1) Simulated bombardment of He gas showed that its pressure remained at 340 KPa before and after bombardment. There is no apparent change in He pressure.

(2) The overall results of the three Xe-124 bombardment runs are summarized in Table 2.

4. Target wash and product separation were done in accordance with the standard production procedures.

5. The results of product analysis and the nuclides obtained are listed in Table 2.

Table 2. Results of Gas Target Test Runs

Item	Test Results
1. Radionuclides purity:	
I-123	> 99.8%
All others	< 0.2%
I-124	Not detected
I-125	Not detected
2. Radiochemical	> 99% I <sup>-</sup>
3. Concentration at end of process	> 0.7 Ci/ml
4. Target window life	1. Window not shattered after three runs, but not reaching 60,000 $\mu$ Ahr. 2. Original manufacturer certificate verified, window normal after 3 runs at 1,500 $\mu$ Ahr.
5. Target yield (EOB + 6 hr) (EOB = end of bombardment)	a. 9.0 mCi/ $\mu$ Ahr b. 9.3 mCi/ $\mu$ Ahr c. 9.6 mCi/ $\mu$ Ahr
6. Noise levels	< 75 dB

Figure 3 [photograph not reproduced] shows the layout of the gas target cave.

## Solid Target System Test and Results

Two solid target systems were also acquired to meet our future needs. Figure 4 [photograph not reproduced] shows a solid target in the radioactive isotope research target chamber. The specifications, test items and results are summarized in the following.

## 1. Leak detection in solid target system.

The system can reach the required vacuum of  $5 \times 10^{-6}$  Torr in 20 minutes.

## 2. Alignment of solid target to the beam.

The beam can effectively bombard the desired area on the target.

## 3. Bombardment of solid target.

Prior to bombardment, the solid target was electroplated with concentrated stable isotopes such as Tl-203, Cd-112 and Zn-68. Each target was bombarded with a 30 MeV proton beam at 120 to 150  $\mu$ A. Each target station was tested 1 to 3 times. The overall activity of each target was measured after 6 hours of bombardment. Six solid target bombardment tests were run after leak check and beam alignment. The production of various nuclides and their radioactivities were measured and the results are shown in Table 3. The overall activity and target bombardment productivity have exceeded specifications.

Table 3. Solid Target Test and Results

	Radioisotope and Specifications	Results (Activity)
Overall radioactivity	Tl-201: 1.2 Ci Tl-201 at EOB + 32 hours	Target #1: 1.39 Ci
		Target #2: 1.55 Ci
		Target #3: 1.48 Ci
Bombardment productivity	In-111: 2.7 Ci In-111 at EOB	Target #1: 6.26 Ci
		Target #2: 3.63 Ci
		Low yield due to cyclotron shutdown (2.5 hours)
	Ga-67: 2.7 Ci Ga-67 at EOB	Target #1: 7.80 Ci
		Target #1: 1.35 mCi/ $\mu$ Ahr
		Target #2: 1.33 mCi/ $\mu$ Ahr
	<sup>203</sup> Tl ( $\geq 97\%$ ) target, <sup>201</sup> Tl $\geq 1.3$ mCi/ $\mu$ Ahr at EOB + 32 hours	Target #3: 1.47 mCi/ $\mu$ Ahr
		Target #1: 5.89 mCi/ $\mu$ Ahr
		Target #2: 3.63 mCi/ $\mu$ Ahr
	<sup>112</sup> Cd ( $\geq 97\%$ ) target, <sup>111</sup> In $\geq 3.0$ mCi/ $\mu$ Ahr at EOB	Target #1: 7.30 mCi/ $\mu$ Ahr
		Target #2: 7.30 mCi/ $\mu$ Ahr
	<sup>68</sup> Zn ( $\geq 97\%$ ) target, <sup>67</sup> Ga $\geq 3.0$ mCi/ $\mu$ Ahr at EOB	Target #1: 7.30 mCi/ $\mu$ Ahr
		Target #2: 7.30 mCi/ $\mu$ Ahr

# Radiation Protection, Radiation Monitoring and Safety Assessment

The following is a summary of radiation safety and protection issues concerning the INER facility in accordance with the experience in operating the CP-42 and TR-30 cyclotrons and targets<sup>[2-8]</sup> acquired by EBCO/TRIUMF and Nordion and the special requirements in Taiwan.

## (A) Radiation Protection Measures

Radiation detectors are installed in critical areas all over the entire facility to monitor the radiation safety in operation. Table 4 shows the monitoring devices employed in the facility. Figure 5 shows the layout of such radiation monitors in the cyclotron area. All radiation monitors are used and periodically calibrated by the radiation protection personnel of the installation. Furthermore, the performance and calibration data of each device are periodically checked.

Table 4. Radiation Detectors Used for Monitoring in the Facility

Detector Type	Location	Quantity	Purpose	Remarks
1. Beam spill detector (ion chamber)	Cyclotron chamber and target caves	6	Monitor beam spillage	10 Sv/h
2. Residual radiation detector (Eberline 270 LND 725 GM tube)	Cyclotron chamber and target caves	6	Monitor gamma dose	1 to 25 mSv/h
3. Gamma detector (Eberline 270 LND 725 GM tube)	Cyclotron chamber, corridor, stairs and basement outside the shielded target chambers	4 2	Monitor gamma dose in shielded working area Monitor gamma dose in basement	1 to 9999 $\mu$ Sv/h
4. Neutron detector (Eberline NRD N, woods G-5-1 BF3)	Cyclotron chamber, corridor, stairs and basement outside the shielded target chambers	4 2	Monitor neutron dose in shielded working area Monitor neutron dose in basement	1 to 9999 $\mu$ Sv/h
5. Air detector (T/A FM5-ABN)		8	Monitor $\alpha$ and $\beta$ particles in air	10 to $10^5$ cpm
6. Smokestack monitor (Bicron 2M2/2 NaI with PMT)	Smokestack	1	Monitor activity, concentration and nuclides discharged	0 to 200 kcps
7. Automatic radiation monitoring system	HP room Control room	2	Display and analyze various detector intensities	
8. Limb detector (APTEC C7M, FT-366, FT-252 GM tube)	HP room hallway Hallway outside lead cells Control-room hallway Product shipping hallway	1 1 1 1	Detect contamination on limbs, hair, and clothing	
9. Gamma detector (Victoreen 808, Eberline ARM-1 GM tube)	Waste fluid in temporary storage in basement Isotope production area	2 2	Monitor gamma dose in waste fluid Monitor gamma in hot lead cells	0 to 1 mSv/H 0 to 1 mSv/h
10. Iodine detector (MAB SJM 1000 ND 302 IM NaI det)	Laboratories	1	Monitor leakage of I-123	1 to $10^4$ Bq/m <sup>3</sup>
11. Door frame detector (Eberline PM-6)	Entrance to radiation control area	1	Monitor personnel contamination	2220 Bq of Sr-90
12. Dynamic dose display apparatus	Entrance to radiation control area	1	Display radiation distribution in control areas	Refresh every 15 sec

## (B) Radiation Detection and Dose Control

The radiation protection plan<sup>[11]</sup> was implemented to control radiation during the test run. In accordance with INER regulation, the control areas are divided into a white zone (2.5  $\mu$ Sv/hr-7.5  $\mu$ Sv/hr), green zone (7.5  $\mu$ Sv/hr-25  $\mu$ Sv/hr), yellow zone (25  $\mu$ Sv/hr-50  $\mu$ Sv/hr), and red zone (> 50  $\mu$ Sv/hr). The following is a summary of radiation detection and dose control data gathered during the test period.

### 1. Radiation detection results:

(1) During the entire test period, the cyclotron control room, power supply room, second-floor conference room and area outside the shielding of the target chamber met the definition of white zone. There was no need to implement any control and the mean dose is below 2.5  $\mu$ Sv/hr.

(2) During operation, radiation dose occasionally reached 8  $\mu$ Sv/hr at the ceiling of the cyclotron chamber and target chamber. Although this is within the green zone limits, it was necessary to limit personnel from entering those areas. The average gamma dose in the



Figure 5. Layout of Radiation Detectors (Designed by EBCO)

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filter room was 20  $\mu\text{Sv/hr}$ . It met the design specification and was operating normally.

(3) When the cyclotron and target caves are operating and during bombardment, the effect on the lead cells were minimal. The radiation dose in the area was less than 2  $\mu\text{Sv/hr}$ .

(4) The gamma exposure values at the main cooling water surfaces of the 151 isotope research target chamber and the 153 solid target chamber exceeded the limits for a green zone. The gamma exposure at approximately 0.5 m from those two points is 25  $\mu\text{Sv/hr}$ . Since the main cooling water pipes were installed and could not be easily relocated, a partial lead shield (4 cm) was used to reduce radiation exposure to minimize its impact on personnel.

(5) The neutron exposure dose rate in the corridor outside the shield of the target chamber reached 41.7  $\mu\text{Sv/hr}$  only when a 210  $\mu\text{A}$ , 30 MeV proton beam was used in the experiment. However, in the development of isotopes at the present time, the maximum current is limited to 180  $\mu\text{A}$ . The radiation exposure in the shielded corridor is slightly higher than the green-zone limit. However, in order to reduce the exposure in the shielded corridor, a sheet of 10-cm-thick, high-density polyethylene was added to the inner wall.

(6) During solid target bombardment, the exposure dose rate of the ion-exchange resin of the cooling water in the common facility room (i.e., room 127 in Figure 5) was as

high as 60  $\mu\text{Sv/hr}$ . A warning sign has been posted there. The area was fenced in and a warning light was installed (and the light flashes when the cyclotron is in operation and ion bombardment is in progress) to restrict access and prevent personnel from getting near the hot spot.

(7) Another five radiation detectors are installed in the basement of the cyclotron, temporary waste fluid storage basement, two lead cells and cyclotron hallway, respectively. During the test run, with the exception that the detector in the cyclotron basement went up to 5-6  $\mu\text{Sv/hr}$ , others remained between the background value and 1  $\mu\text{Sv/hr}$ . The readings were very stable and the numbers were displayed at the entrance to the radiation control area outside the health physics office. The intent of this arrangement is to allow personnel entering the control area to know the distribution of radiation in the control area to ensure their safety.

## 2. Dose control

(1) A work order is required for any worker to enter the control area. Radiation protection personnel must be notified. The worker must wear protective gear in accordance with the test plan or follow the recommendation of radiation protection personnel.

(2) On the basis of the records of the dose readings, the collective dose is 6.93 mSv. The dose analysis data is shown in Table 5.

Table 5. Collective Dose Statistics in Test Run

Work Unit	EBCO	Nordion	Cyclotron	Isotope Production	Common System and Health Physics	Total
Collective dose (mSv)	1.37	1.78	0.69	2.58	0.51	6.93

## Safety Assessment and Discussion

1. Because personnel are well trained, instruments were calibrated and tested, background information was available, and due to excellent preparation work such as the radiation measurement plan and radiation shielding leakage, the radiation protection plan was successfully implemented during this test.

2. During bombardment of targets for the (p,3n) nuclear reaction, the radiation intensity on the outside wall (north) of rooms 151 and 152 (see Figure 5) reached the limit of the green zone (i.e., 25  $\mu\text{Sv/hr}$ ). Therefore, a neutron shield was added to the inner wall of room 151 to reduce the radiation intensity on the outside wall.

3. The radiation exposure rate in a part of the cooling water pipe outside rooms 151 and 153 was as high as 600  $\mu\text{Sv/hr}$ . After adding a 4-cm lead shield, it has met the green-zone limit.

4. During solid target bombardment, the exposure rate of the cooling water ion-exchange resin in the common

equipment room (room 127) was high. Hence, it is included in the control area to restrict access to workers to prevent contact by maintenance and repair personnel. When the cyclotron is in operation, the warning light on the fence outside the room will flash and the gate will be locked.

5. Radiation levels at the roof of the cyclotron chamber and target room were found to exceed the white-zone limit when target bombardment was in progress. Therefore, personnel must be restricted from entering the area and warning lights installed to prevent unnecessary personnel from approaching or staying in the area.

6. The effect of other operating nuclear facilities on the dose of this facility must not be neglected.

7. An abnormal event wherein a solid target was jammed during transport took place during the test run. The pneumatic tube was modified. If it breaks down again, it will be fixed under the direction of the area control personnel. In order to meet operational needs, detectors around lead cells H2 and H3 have been moved to areas under the lead glass of H3 to provide warning.

### Conclusions

After two and a half months of tests involving EBCO/TRIUMF, Nordion and INER personnel, the following conclusions have been reached.

(1) Functional tests of the TR30/15 compact cyclotron were successfully completed on 12 July 1993. All specifications were met and the performance is satisfactory. It is the first cyclotron of its kind in the world to successfully produce a 150  $\mu$ A deuteron beam and is considered a state-of-the-art technology.

(2) The gas and solid target systems were successfully tested on June 7 and 10, 1993, respectively. Performance specifications were met and 5.2 Ci of I-123, 1.55 Ci of Tl-201, 7.80 Ci of Ga-67 and 6.26 Ci of In-111 have been produced.

(3) The shields of the cyclotron chamber and target caves were found to meet design specifications. The safety of the operators can be ensured and regulations concerning radiation protection have been met.

(4) The radiation dose at the main solid target cooling water outlet is high during the test. A 4-cm lead shield has been added. The neutron dose on the outside wall of the isotope R&D room (room 151 in Figure 5) approaches the upper limit for the green zone. A 10-cm-thick, high-density polyethylene sheet has been added to the inside wall. During operation, the ceiling of the cyclotron chamber and target caves is above the limit of the white zone. A warning sign and light have been added to restrict access to the area. In conjunction with radiation protection protocols, safe operation of the equipment and radiation protection of the personnel can be assured.

This facility is constructed to meet future needs in Taiwan. Maximum benefits in civilian applications of

atomic energy will result as the facility operates effectively in the future. This facility includes integrated state-of-the-art technology that can be used for clinical studies in various hospitals and research institutions in Taiwan to push our nuclear medicine and clinical diagnostic technology into a new era.

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## National Developments

**Power Output Could Hit 900 Billion kWh in 1994**  
40100086A Beijing CHINA DAILY [ECONOMICS]  
in English 25 Jul 94 p 2

[Article by Chang Weimin: "Power Production Hits New Record"]

[FBIS Transcribed Text] Thanks to massive reserves of coal and water at thermal- and hydropower plants, China's electrical output is expected to rise sharply this year.

With efforts by the Ministry of Power Industry, whose enterprises generate 70 percent of the nation's output, power production this year is likely to reach 900 billion kilowatt-hours.

Jiang Shaojun, the ministry's spokesman, said the anticipated production represents a 10.7 percent increase over last year.

This weekend the ministry reported that 437.4 billion kilowatt-hours were generated in the first half of this year, up 11.31 percent from the same period last year.

Of the output, which represents 54.7 percent of the planned yearly total, 73.7 billion kilowatt-hours were generated by hydropower plants, 19 percent more than in the same period last year.

Despite the double-digit output growth, rising demand put pressure on the industry. Power failures have occurred more frequently, especially in areas with booming economies.

Guangdong experienced the highest rise in demand, using 34.6 percent more power than last year. The lowest increase in demand, at 3.5 percent, was in the three northeastern provinces of Heilongjiang, Jilin and Liaoning.

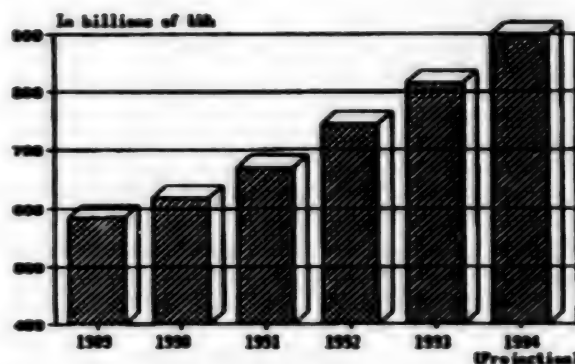
The ministry spokesman attributed the low demand in the northeastern provinces to their decline in industrial production.

Demand in the provinces of Guizhou, Hainan and Yunnan rose by 27.5 percent, 24.9 percent, and 22.5 percent, respectively.

Jiang said China expects to install more generators to eliminate the power shortages that have lingered for 24 successive years.

From January through June, 21 sets of generators, with a combined capacity of 3.6 million kilowatts, have passed a trial run or are already operating. They represent 35 percent of the State plan for this year. Jiang said the bulk of yearly goal is usually met in the latter half of the year.

The government plans to install large- and medium-size generators that can produce 10.2 million kilowatts a year.



Source: Ministry of Power Industry

Electricity Output

If small generators are included, the country will have an additional capacity of 13 million kilowatts this year.

To curb overheated capital construction and rising inflation, the central government did not approve any new power projects in the first half of this year.

However, Ran Yin, director of the ministry's Planning Department, said the State Planning Commission will approve several projects in the coming months.

On behalf of the ministry, Jiang called for the planning of more projects so that the power generating capacity will increase steadily in the next seven years.

It takes three to four years, for example, to construct a thermal power plant. Therefore, preparation for a new plant should begin as soon as possible.

To solve the existing power shortage and meet rising demand, increases in power generating capacity should exceed economic growth, which is planned at 8 to 9 percent for the next seven years.

To make good use of the rich water resources in the country, the ministry expects to install hydropower generators that can produce 31 million kilowatts.

That means that hydropower generating capacity will be increased to 75 million kilowatts, 25 percent of the total. China now has hydropower generators that produce 44 million kilowatts, or 22.4 percent of the total.

### Figures in on Power Production for First Half of 1994

94P60347 Beijing JINGJI RIBAO [ECONOMIC DAILY] in Chinese 7 Jul 94 p 1

[FBIS Translated Text] The electric power industry experienced excellent growth for the first half of 1994. As of 20 June, the nation had generated 409.774 billion kilowatt-hours of electricity, an increase of 11.02 percent over the same period in 1993. Of this total, hydropower accounted for 67.23 billion kilowatt-hours, thermal



power accounted for 337.01 billion kilowatt-hours, and nuclear power accounted for 5.534 billion kilowatt-hours.

From January through May, the nation's coal consumption rate for power production was 408.62 kilograms per kilowatt-hour, 3.75 kilograms per kilowatt-hour less than the same period in 1993. China's electric power enterprises actually sold 239.7 billion kilowatt-hours of electricity to earn 49.1 billion yuan which had a real tax value of 8.25 billion yuan. These figures represent increases of 7.8 percent, 34 percent, and 47.8 percent, respectively, over the same period of 1993.

In the first half of this year, the nation saw sustained growth in electric power output, maintaining a rate of increase of more than 11 percent. As a result of added hydropower capacity and good water storage levels at the first of the year, power output in the south showed a notable increase. Because of drought in much of the northern part of the country, power output was down compared to the same period of 1993. In May, the East China Grid reached its largest load—19.86 million kilowatts; this represented an increase of 2.78 million kilowatts, ranking this grid first among the country's five major power grids.

#### **Big Four Power Companies Seek More Foreign Investment**

40100086B Beijing CHINA DAILY in English 23 Jul 94  
p 1

[Article by Chang Weimin: "Electricity Companies Seek More Investment"]

[FBIS Transcribed Text] The Ministry of Power Industry yesterday revealed the terms and conditions for foreign investment in the country's top four electricity companies.

The companies, which will soon be listed on international securities markets, are wooing foreign money in a bid to increase output to meet growing domestic demand.

The country aims to increase generating capacity by 63 percent over the next seven years, according to ministry spokesman Jiang Shaojun.

But the target of 17 million kilowatts worth of new power generators each year would prove "a difficult task," he said.

The ministry unveiled the electricity pricing principles behind the listing of the four companies: Shandong Huaneng Power Generation, Huaneng International Power Development, Shandong International Power Source Development and Datong Power Plant.

Huaneng International will be listed on the New York Stock Exchange in September, and Shandong Huaneng will also be floated there soon. The other two will be listed in Hong Kong in the near future, Jiang said.

The pricing formula principles are:

- that prices will take account of production costs, fees, taxes and profits;
- and that after-tax profits will be worked out following standard accounting methods, which will consider the net value of fixed assets.

Jiang said investors will get a return of 15 percent from the four holding companies.

Returns above 15 percent may be obtained if the holding firms are efficiently managed, he said.

Jiang said the ministry believes the four company listings will be a success.

He said the floatations form an important part of the country's power reforms.

Power output in the first half of this year was 437.4 billion kilowatt-hours, Jiang said.

An additional 20 percent was needed to meet demand.

Last year capacity stood at 183 million kilowatts.

The power shortfall has caused a "bottleneck" hindering national economic development, he said.

By the end of last year, China had signed \$14.3 billion worth of power contracts with foreigners, of which \$10.4 billion has so far been used.

#### **Experimental Rural Energy Plan To Go National**

40100088A Beijing CHINA DAILY in English 5 Aug 94  
p 1

[Article by Wang Yonghong: "Rural Plan To Tap New Energies To Go National"]

[FBIS Transcribed Text] A three-year experimental project to tap new energy sources in rural China has proved so successful that the government plans to go nationwide with it starting the end of 1995, an agricultural official revealed yesterday.

The project, both energy saving and environmentally friendly, was initially launched in 100 selected counties across the country, according to Bai Jingmin of the Department of Environmental Protection and Energy Development under the Ministry of Agriculture.

Backed by financial and technical support from both central and provincial authorities, the counties focused their efforts on developing such energy sources as wind, solar and biogas power, while designing new fuel-saving stoves for rural households.

"The project was prompted by the faster-than-ever rural economic growth, which has caused rural energy consumption to spiral in recent years," Bai said.

Last year, energy consumed in rural areas amounted to 325 million tons of standard coal, accounting for 32 percent of the country's total.

Forty percent of this power was used for agricultural and industrial production, according to Deng Keyun, deputy director of the department.

Moreover, power consumption in rural areas is growing at 9 percent annually, surpassing the country's energy growth rate, she added.

"It is imperative for rural areas to tap and make best use of rural energy resources such as biogas, solar energy, water power, wind power and bio-energy while developing energy-saving practices in order for rural communities to be self-sufficient in terms of their energy requirements, whether household or industrial," said Deng.

To encourage adoption of the project, the central government offered some preferential policies and special funds to those counties that tapped new energy resources.

A total of 11.3 billion yuan (\$1.3 billion), from central government loans and local fund-raising, has been injected into the project over the past three years.

In the last two and a half years, the project has succeeded in saving and generating energy equivalent to 80 million tons of standard coal per year—through the widespread use of solar cookers, methane-generating pits, firewood or coal-saving stoves.

#### Inner Mongolia Now Described as "Major Energy Supplier"

40100090A Beijing CHINA DAILY (Economics)  
in English 15 Aug 94 p 2

[FBIS Transcribed Text] Hohhot (Xinhua)—The Inner Mongolian Autonomous Region has become a major energy producer.

The region in North China has increased annual production of coal and electricity by 20 percent when most other parts are facing a power shortage.

According to a regional official, the region's energy industry has produced one-seventh of its industrial output value. The region supplied Beijing with 1.42 billion kilowatt-hours of electricity in the first half of this year alone and is expected to push the power supply to 8.67 billion kilowatt-hours next year.

Statistics from the regional planning commission show that the region sold 18.47 million tons of coal to other parts of China and 520,000 tons abroad, and also provided Northeast and North China with 9.14 billion kilowatt-hours of electricity last year.

As one of China's five energy production bases, Inner Mongolia is rich in coal reserves, with coal reserve zones equivalent to the total land area of Jiangsu Province in East China.

The region has discovered more than 300 coal fields with a proven reserve of 225.3 billion tons, an amount which can supply the entire country for 200 years based on current coal consumption.

#### China's Installed Capacity, Power Output in 1993 946B0136B Beijing ZHONGGUO DIANLI in Chinese No 7, 5 Jul 94 p 72

[Article by the Statistical Analysis Office of the Planning Department of the Ministry of Electric Power Industry]

[FBIS Translated Text]

Table 1. China's Installed Capacity and Power Output in 1993

Region	China's Installed Capacity in 1993		
	Installed capacity (MW)		
	Total	Hydroelectric power	Thermal power
National total	182910.7	44092.5	138818.2
Northern China	28351.4	1267.3	27084.1
Beijing	2752.5	270.9	2481.6
Tianjin	3196.0	5.0	3191.0
Hebei Province	9113.0	673.7	8439.3
Shanxi Province	8522.4	274.0	8248.3
Inner Mongolia	4767.7	43.7	4723.9
Northeast China	24297.3	4379.9	19917.7
Liaoning Province	10214.9	1183.7	9031.2
Jilin Province	6322.2	2985.6	3336.6
Heilongjiang Province	7760.2	210.3	7549.9
Eastern China	52528.2	7076.5	45451.7
Shanghai	7647.4		7647.4
Jiangsu Province	12490.4	29.0	12461.4
Zhejiang Province	7725.4	2440.3	5285.1
Anhui Province	5292.1	498.1	4794.0
Fujian Province	4277.7	2545.2	1732.6
Jiangxi Province	3045.8	1488.4	2357.4
Shandong Province	11249.3	75.5	11173.8
Central Southern China	44030.8	16609.1	27341.7
Henan Province	8308.4	572.7	7735.8
Hubei Province	9047.5	5780.9	3266.6
Hunan Province	6657.7	3296.0	3361.7
Guangdong Province	14758.9	4020.8	10738.1
Guangxi Autonomous Region	4361.0	2658.8	1702.2
Hainan Province	897.2	359.9	537.3
Southwestern China	18380.6	9175.4	9205.2

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Sichuan Province	10527.1	4558.9	5968.2
Guizhou Province	3170.8	1394.1	1776.7
Yunnan Province	4516.1	3101.5	1414.6
Tibet	166.7	120.9	45.7
Northwestern China	14882.4	5864.6	9017.8
Shaanxi Province	4430.7	1198.0	3232.7
Gansu Province	4532.5	2357.7	2174.8
Qinghai Province	1723.7	1385.1	338.5
Ningxia Autonomous Region	1642.3	276.3	1366.0
Xinjiang Autonomous Region	2553.3	647.5	1905.8
Regions not distinguished	440.0	440.0	

China's Generated Power in 1993

Region	Generated power (TWh)		
	Total	Hydroelectric power	Thermal power
National Total	837.407	151.602	685.805
Northern China	141.462	1.970	139.492
Beijing	14.109	0.272	13.837
Tianjin	12.617	0.017	12.600
Hebei Province	49.434	0.871	48.563
Shanxi Province	41.782	0.697	41.085
Inner Mongolia	23.521	0.113	23.407
Northeast China	112.183	8.317	103.866
Liaoning Province	50.458	2.779	47.679
Jilin Province	24.494	4.985	19.508
Heilongjiang Province	37.232	0.553	36.679
Eastern China	244.282	20.705	223.577
Shanghai	37.331		37.331
Jiangsu Province	53.665	0.055	53.609
Zhejiang Province	30.713	6.265	24.447
Anhui Province	26.664	1.107	25.557
Fujian Province	19.524	8.976	10.549
Jiangxi Province	15.313	4.262	11.051
Shandong Province	61.073	0.040	61.033
Central Southern China	189.760	62.377	127.483
Henan Province	44.066		42.164
Hubei Province	41.226		14.827
Hunan Province	27.271	12.672	14.599
Guangdong Province	57.277	10.596	46.681
Guangxi Autonomous Region	17.450	10.083	7.368

Hainan Province	2.469	0.658	1.811
Southwestern China	78.797	34.461	44.336
Sichuan Province	47.086	19.586	27.500
Guizhou Province	14.250	4.946	9.303
Yunnan Province	17.104	9.667	7.437
Tibet	0.357	0.262	0.095
Northwestern China	69.525	22.441	47.084
Shaanxi Province	21.598	3.839	17.759
Gansu Province	22.771	10.207	12.564
Qinghai Province	6.828	5.312	1.517
Ningxia Autonomous Region	8.709	1.045	7.704
Xinjiang Autonomous Region	9.578	2.038	7.540
Regions not distinguished	1.398	1.398	

### End of Power Shortage Could Be Seen by Year 2000

94680136D Beijing KEJI XUEBAO [CHINESE SCIENCE AND TECHNOLOGY DAILY] in Chinese 22 Jun 94 p 1

[Article by correspondent Qu Jian [4234 0494]]

[FBI5 Translated Text] Beijing, 21 June—In the next seven years, the goal of China's electric power industry is to build power plants to ensure a balanced supply and demand for electricity by the end of this century following a policy that stresses both development and conservation. This is the message received by this reporter at the "national electric power science and technology workshop."

In order to ensure the realization of this strategic objective by the year 2000, in the next seven years the elastic coefficient for electric power will remain at one. Electric capacity and generated power will increase at an annual rate of 8-9 percent. By the end of the century, China will have a total installed capacity of 300 million kW. In addition to developing the supply of electricity, power grids will also be built accordingly. We will take advantage of the opportunity of the Three Gorges hydroelectric project to bring trans-regional power grids on line by the year 2000. Under the premise that the GNP will grow at an annual rate of 8-9 percent and the amount of electric power consumed by society to produce a unit product will decrease by 8-10 percent by the year 2000, power shortage in China can essentially be alleviated by then. At the same time, no county will be left without electric power and over 95 percent of rural households will be electrified; 1000 counties will meet the rural electrification standard (among them, 600 will meet the preliminary electrification standard).

To accomplish this goal, the Ministry of Electric Power Industry has formulated a technical development



strategy that spans two centuries. We will develop and promote suitable technology to modernize our existing industries and to push the technology of our the electric power industry forward. We will develop new technology so that we can make breakthroughs in the key technical areas related to electric power production, construction and development. We will also speed up the pace of commercialization for such products. In addition, the trend of development worldwide will be monitored in order to guide and support long-range and strategically important projects. To this end, the Ministry of Power Industry has established four different mechanisms, including the establishment of a new pricing mechanism, a revolving hydroelectric development mechanism, a revolving nuclear power development mechanism and a foreign investment utilization mechanism, to support the construction of trans-regional power grids, electric power subsidy plans, energy conservation projects, and clean coal technology.

#### **Ningxia at Forefront of Nation's Rural Electrification Effort**

946B0136F Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 16 Jul 94 p 1

[Article by Wang Cunli [3769 1317 3810], Xinhua News Agency]

[FIRS Translated Text] Ningxia is taking full advantage of its abundant resources to accelerate the pace of rural electrification. As of the end of last year, two of the 21 electrified counties are in Ningxia. Recently, Helan county passed inspection at the provincial level. Other than the individual electricity usage indicator, the eight counties and cities in the region where water from the Huang He is diverted for irrigation also meet the rural electrification standard. Ningxia is at the forefront of rural electrification in China.

The Huang He bends nine times in the province, which also has an abundance of coal. These factors make Ningxia uniquely suited for the energy industry. The region has four thermal power plants and one hydroelectric power station. The combined installed capacity is 1.5 million kW. The amount of generated power per capita is 2.5 times higher than the national average. It is one of a few provinces that are exporting electric power. On this basis, Ningxia dedicated its manpower and resources to solve the problem of rural electrification. The goal of having electricity in every village was realized in 1992.

#### **Three Gorges Will Spawn Enormous Markets for Raw Materials, Transportation, Construction and Technology**

946B0145A Shanghai WEN HUI BAO in Chinese 19 Jul 94 p 5

[Article by Huang Xuanchuan [7806 1357 0278]: "Five Major Markets for the Three Gorges"]

[FIRS Translated Text] Attracted by the enormous size of the project, the entire country and the rest of the world are optimistic about the Three Gorges market. Various groups are visiting the Three Gorges to conduct market surveys, promote products and secure engineering contracts. Vice President Qin Zhongyi [4440 0022 0001] of the Three Gorges Development Corporation divided the market into five major segments.

#### **Capital Market**

According to the price level as of May 1993, both static and dynamic investments of the project are enormous.

The government is relying on two major sources of income to fund the Three Gorges. One is from an increase in the cost of electricity sold nationwide and the other to incorporate the Gezhouba Hydropower Plant into the Three Gorges Corporation and spend its entire revenue on the Three Gorges. These two sources will generate 32.7 billion yuan in the first 11 years and will still leave a deficit of 20.8 yuan.

According to the Three Gorges Development Corporation, there are three ways to raise additional funds. The ownership of the Gezhouba Hydropower Plant can be restructured in order to issue stocks worldwide at a suitable time. Foreign funds can be used in the form of export loans, commercial loans and international monetary agency loans. Lastly, money can be raised by issue bonds or setting investment trust funds.

These measures will have a positive effect on the growth of the capital market. A multi-faceted approach is being used by the region to accelerate the population relocation process. One approach is to require contractors to invest in the project and viewing such investments as an important aspect of contract awards. Another way is to encourage companies to invest in the region to support the project. Yet another way to pay for it is to mobilize the public to work voluntarily without compensation for the project.

#### **Materials Market**

Approximately two-thirds of the enormous budget for the Three Gorges will be spent on materials and equipment. It is estimated that the Three Gorges will need the following construction materials: 10.8 million tons of cement, 1.95 million tons of steel, 1.6 million cubic meters of lumber, 10 million tons of building construction materials, 100,000 tons of explosives, 1 million tons of oil and 65 million tons of gravel and sand. To relocate the population, it requires 690,000 tons of steel, 1.34 cubic meters of lumber and 4.6 million tons of cement. Presently, the focus is to get the preparatory work done before it officially starts. Major types of equipment required include digging and road construction machinery such as digging machines, loaders, transport vehicles, bulldozers and concrete mixers.

#### **Construction Market**

The Three Gorges dam needs 100 million cubic meters of construction work both above and beneath water in a

5-6 square kilometer area. Thirty million cubic meters of concrete needs to be poured and 250,000 tons of metal structure must be erected. Ship lifters capable of lifting 11,000 tons of weight vertically for up to 110 meters must be built to allow 3,000-ton class vessels to pass. A five-stage two-way lock capable of passing 10,000-ton class fleets needs to be constructed. Twenty-six huge water turbine generators with an individual capacity of 700,000 kW each, the largest in the world, must be installed. Fifteen ultra-high voltage long distance power transmission circuits must be built. Both the amount and the magnitude of work are unprecedented.

The population relocation project in the plant area is also difficult and complicated. According to the 17 year construction plan, 1 million people must be relocated within this short time span. Thirteen counties and cities and 140 villages must be moved. It involves the construction of a total of 21.75 million square meters of building space, including 11.04 million square meters of urban building space, 6.57 million square meters of rural residential building space, 4.14 million square meters of industrial and mining building space, restoration of 956 kilometers of highway, relocation of 44 cultural landmarks, construction of communications poles that covers 1,826 kilometers, 5,279 kilometers of broadcasting circuits and 1,080 kilometers of power lines.

#### Transportation Market

During the construction period of the Three Gorges, passenger and cargo transportation are equally important. According to the authority, there will be 100,000 construction workers, 20,000 civilian volunteers and 20,000 to 40,000 migrants in the area during the construction period. Over 200 million passengers will have to be transported annually. On the basis of the dam construction project, a total of 40 million tons of materials will have to be transported, including 15 million tons of commercial goods and 25 million tons of sand and gravel. The peak load is expected to reach 1.8 million tons per year.

According to a flow analysis of the transportation requirement of the dam construction project, most of the need is between Yichang and the dam site. Twenty-seven million tons will be transported via highway and railroad and 13 million tons will be shipped by water. Yichang is only 40 kilometers away from the Three Gorges site. To transport such a large amount of materials over such a short distance will require a large number of vehicles and boats. Thousands of boats will be shipping sand and gravel on the river in the early stage of the construction project.

#### Technology Market

The Three Gorges is a technologically complicated project that requires considerable technical development and applications. Many subjects in the pivot project, such as water turbine generators and high capacity high

voltage power systems, manufacture of electric equipment, silt buildup, high strength dam building technology, high speed water flow, and project organization and technical management, are unprecedented. It also takes considerable science and technology to handle the relocation of over a million residents and to keep the economy growing in the region. From the standpoint of agriculture, we must deal with soil retention, mud slide prevention, environmental protection and migration of population. In terms of industry, 657 businesses below 175 meters in elevation above sea level will be submerged. A total of 818 million yuan of fixed assets will be lost. Industries will be relocated and rebuilt to meet the needs of the market economy in terms of size, level and quality. Most businesses will adopt new technologies and new equipment to make them more competitive. Some businesses will lose the sources of their raw materials to the rising water. They will have to apply new technologies to create new products.

The owners of the Three Gorges are responsible for the construction project. Construction is organized on the basis of international customs in a market economy. A competitive bidding mechanism is used to locate contractors for various aspects of construction, equipment and materials to ensure the project is completed with the least amount of time and cost and of the highest quality.

The Three Gorges is open for bidding to the entire country and to the rest of the world. A variety of well-known companies have made contact with the project. As of the end of May, more than 50 companies had registered at Yichang to compete in the project.

As for contract solicitation, 37 projects have solicited bids. Eighteen projects have been awarded to 20 winners out of over 100 potential bidders. The total contract awards exceeded 4 billion yuan. Of this, 3.7 billion yuan of investment is spent on civil engineering projects. Twelve projects, or 75 percent of the total capital, were awarded to businesses owned by the province of Hubei and by companies owned by the central government that operate in Hubei.

In the area of equipment, to meet the needs to move 35 million cubic meters of dirt and rocks this year, bids were solicited worldwide for earth moving equipment. The winners include Ingersoll Rand and Carter of the United States, China Heavy Motor Corporation, Atlas of Sweden, and Kenubo (?) of Germany. A total of seven contracts were signed, including a total of 64 pieces of equipment such as heavy duty automatic loading vehicles, large earth digging and hydraulic drilling machinery, loaders, and bulldozers.

#### Energy Production, January-April 1994

94P60328A Beijing ZHONGGUO NENGYUAN  
[ENERGY OF CHINA] in Chinese No 6, 25 Jun 94 p 5

[FBIS Translated Text]

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Energy Production, January-April 1994

	Unit	January		Jan-Apr 1994 % Increase Over Same Period of 1993
		Cumulative	Current Worth	
Total energy output	10,000 tons standard coal	33,214	9,422	3.5
Raw coal	"	35,076	10,337	3.6
Unified distribution mines	"	15,279	3,984	0.6
Local small, medium mines	"	19,797	6,353	6.0
Clean coking coal	"	2,162	577	7.7
Coke (machine coke)	"	2,136	552	11.4
Crude oil	"	4,839	1,189	1.9
Processed crude	"	4,384.2	1,115.8	2.6
Gasoline	"	979	273	-5.6
Kerosene	"	153.9	38.5	31.1
Diesel	"	1,114.7	312.3	-0.5
Lubricating oil	"	69.5	19.6	-7.7
Heavy oil	"	982.5	248.2	-4.7
Natural gas	100 million m <sup>3</sup>	55.1	13.8	1.1
Electric power	100 million kWh	2,857.1	728.1	11.3
Hydropower	"	416.9	126.6	25.0
Thermal power	"	2,403.2	589.7	7.7

Source: State Statistical Bureau

**Guizhou Rapidly Developing Local Electric Power**  
946B0136A Guiyang GUIZHOU RIBAO in Chinese  
7 Jul 94 p 1

[Article by Liu Zengbing [0491 2582 0365]: "Guizhou Rapidly Developing Local Electric Power"]

[FBIS Translated Excerpts] Guizhou is rapidly developing local electric power and has 714,000 kW of installed capacity that generates 2.128 billion kWh per year. On the average, the generators are used 3,038 hours per year.

Last year, we had 1,282 local power plants with a total of 2,061 generator units. The average plant had an installed capacity of 557 kW, which is 35.5 times that of 10 years ago. The number of yearly equipment utilization hours has risen to 3,038 hours from 1,740 hours recorded 10 years ago. A total of 50 counties, 58 percent of the administrative regions in the province, have electricity for production, illumination and civilian use. The amount of electricity consumed is 1.5 billion kWh, 2.5 times that consumed a decade ago. In 1993, the local electric utilities added 2,072 kilometers of new high voltage power transmission lines, 2,654 kilometers of low voltage power transmission lines, 60,000 kVA of stepping-up transformers and 45,000 kVA of stepping-down transformers. In the province, 88.1 percent of the towns, 67.57 percent of the villages and 57.06 percent of

the households have been electrified. Last year alone, 18,800 kW of installed capacity was added. Construction on another 189,700 kW of installed capacity was under way. A portion of the generators under construction may be producing electricity by the end of this year.

Electric power plants are being built in Guanling, Luodian, Wengan, and Meitan. The two 6,300 kW generators at the Jiaokou power plant in Meitan could be operational in 1995. Construction is currently under way on the Xinduanqiao power plant in Guanling, Leigongtan power plant in Luodian, Hualongkou power plant in Wengan, and Yangdu power plant in Daozhen. They will be completed as soon as possible.

**Sichuan Sets Policy for Primary Energy Development**

946B0117C Chengdu SICHUAN RIBAO in Chinese  
6 May 94 p 1

[Article by Xiong Dabin [3574 1129 2430]]

[FBIS Translated Text] On 5 May, the Sichuan Province Planning Commission announced an energy development policy calling for faster primary energy development, more research on developing new agricultural energy resources and other renewable energy resources, and bringing about a coordinated development of the energy production structure.

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Last year, progress was made in the production of Sichuan's primary energy resources: electricity, coal, and natural gas. By the end of last year, the total installed capacity for electric power reached 10,500MW, fourth among all the provinces and regions in the country, but there is still a serious shortage of electric power, which last year caused losses of about 30 billion yuan in industrial output value. To meet industrial and agricultural production needs, Sichuan plans to reach a total installed capacity of 18,000MW to 20,000MW by the year 2000. The present scale of provincial electric power construction is about 6,500MW, and local installed capacity is growing at about 200MW to 300MW each year. Last year's coal production topped 81 million tons, quadruple that of 1980, fulfilling the "Eighth 5-Year Plan" target two years ahead of schedule. Hereafter there will be a unified plan for the development of coal resources, large, medium, and small will be combined, as will state-operated and collective, and new, key mining districts will be developed on the basis of the good and solid, old mining districts. Last year, natural gas output in Sichuan was 7 billion cubic meters, 27.3 percent over that of 1985, and commercial gas supply for export was 60 percent that of the whole country. But, natural gas for consumers was still running shortfalls as high as 1.4 to 2 billion cubic meters during the "Eighth 5-Year Plan" period. The World Bank has now listed the "Sichuan natural gas development and energy conservation project" in its loan plan for the 1994 fiscal year.

#### **Eastern Fujian Adding More Hydropower Stations**

946B0122B Fuzhou FUJIAN RIBAO in Chinese  
17 May 94 p 1

[Article by Wang Renmo [3769 0086 1075] and Huang Zhongxing [7806 0112 2502]: "Quanzhou's Effective Fight to Turn Its Electric Power Situation Around"]

[FBIS Translated Text] Quanzhou City, which has suffered from serious power shortages, has combined long-term and short-term measures and has used both internal and external sources to accelerate power industry development. It has completed four 220-kV transformer stations, reaching a total capacity of 900,000 kVA, which places it first in the province. The growth rate of electric power in Quanzhou has been at least 30 percent for each of the last six years. With the extraordinarily rapid growth of Quanzhou's economy in recent years, power shortages reached approximately 30 percent. In response, Quanzhou adopted a preferential policy in which it mobilized all of society, used a variety of channels to raise more than 500 million yuan, and built four 200-kV transformer stations, at Jingshan, Hui'an, Shishi, and Guanyao, and 18 110-kVA power plants, forming a regional loop network that provides a consistently high rate of increase in power delivery to the entire city. In its fight to turn its electric power situation around, Quanzhou combined long-term and short-term measures and emphasized both internal and external sources. While accelerating the construction of the Quanzhou regional power grid, it also undertook the construction of the Nanpu fossil-fired power plant in Hui'an, with a first-stage generating capacity of 700,000 kW, then built a large 2.4 million

kW port-area fossil-fired power plant in order to correct the inefficient distribution of power plants in the province's power grid and to deal with inadequate construction rates in the Quanzhou regional power grid.

As short-term measures, it identified additional conservation potential, accelerated emergency power plant construction and bought power use rights from outside the area, which alleviated the immediate shortage of electric power. A generating unit using an advanced French diesel generator, with a maximum capacity of 48,000 kW, representing an investment of 250 million yuan, is rapidly being built at Shenhu in Jinjiang County and is expected to be completed by the end of the year. Quanzhou's counties and cities spent over 100 million yuan to buy more than 200 million kWh of electric power from outside the region. By using both internal and external sources and engaging in multichannel fund raising, Quanzhou overcame its shortage of funds. For example, most of the more than 71 million yuan of construction funding for the first stage of the Guanyao 200-kV transformer station was obtained through bank loans; the station was formally commissioned on 12 March of this year. The investment in the Nanpu fossil-fired power plant is nearly 4 billion yuan; an agreement for cooperative construction of fossil-fired power plants has been signed with the Aiyisi [phonetic] Chinese Power Generating Corporation, Inc., located in the United States, with a total investment of \$500 million, of which 70 percent is foreign capital, and it is expected that the first stage will be commissioned in 1997.

#### **Accelerated Construction Helps Ease Power Crunch in Southern Fujian**

946B0122A Fuzhou FUJIAN RIBAO in Chinese  
7 May 94 p 1

[Article by reporter Chen Chonglong [7115 1504 7893]: "Vigorous Power Industry Construction in Southern Fujian"]

[FBIS Translated Text] As the Eighth 5-Year Plan began, a vigorous round of power industry development began in southern Fujian Province, laying the groundwork for an end to the region's economic backwardness. The region now has a total installed hydropower generating capacity of 185,000 kW and delivers an average of 600 million kWh a year; these figures are respectively three and four times the 1978 values. The region has 7068 km of high-voltage power lines and was integrated into the province-wide power grid in 1992, ending the long-standing isolation of southern Fujian from the main power grid. The 100-kV grid covering the five northern counties of the area is the country's biggest regional power grid. In hydropower construction, Ningde Prefecture has equally emphasized large, medium and small plants. The State Council has authorized the construction of the large Muyangxi cascade, with an installed capacity of 400,000 kW, representing an investment of more than 2 billion yuan.

Preparations for construction are already in full swing, and the main project may begin within the year. The middle-sized Sangyuan power plant in Fuding County, with a

planned capacity of 35,700 kW, and the Huanglanxi power plant in Fu'an County, with a planned capacity of 36,000 kW, are now under construction and more than half completed. Small hydroelectric plants with a combined capacity of 60,000 kW are expected to be commissioned soon. Ningde Prefecture is making efforts to bring market structures into hydropower construction. Eastern Fujian's finance departments at all levels have severely limited resources; therefore, they have made effective and thorough use of central and province-level policies favoring the development and modernization of water conservancy and hydropower facilities; in addition they have used multi-channel fund raising, vigorously encouraging various types of joint-stock electric power construction as well as the construction of power plants by private organizations, which has brought in large amounts of funds from outside the area and idle capital from society. For example, the Muyangxi power plant is a joint venture of the Ministry of Water Conservancy, the province Hydropower Department, and the prefecture Hydropower Bureau, which will jointly build and manage it and will share the profits and the risk. More than 3 million of the nearly 10 million yuan needed for the technical modernization of the Dazexi plant was raised by the sale of stock to employees. In January of this year, a private power plant was built with funding by several peasants in Kanguo village, Fu'an City. During the Ninth 5-Year Plan, eastern Fujian is scheduled to have a million kilowatts of installed capacity and to produce 3 billion kWh of energy a year (including facilities under construction), which will make it one of the province's major hydropower centers.

### Hydropower

#### First Unit of 510MW Dongfeng Station To Be Operational Soon

40100088B Beijing CHINA DAILY in English 5 Aug 94 p 2

[FBIS Transcribed Excerpts] Guiyang (Xinhua)—The Dongfeng Hydropower [Station] in Guizhou Province, Southwest China, will have its first generating unit operational by the end of this month.

Officials at the site said that the station, located on the Wu Jiang, has an installed generating capacity of 510,000 kilowatts, and will be able to produce 2.4 billion kilowatt-hours of electricity [a year] upon completion. It is the second major hydropower station on this major tributary of the Yangtze River. [Passage omitted]

The dam is 162 metres high and 25 metres wide at the base. The officials said that it is by far the highest and thinnest dam in Asia.

The dam is also the first one in China to use cinders, which, the officials said, reduced by more than half the amount of cement which would otherwise have been used.

In another development, the officials said, the government has decided to form a Wu Jiang hydropower

development company that will develop the rich power resources on the river in a commercial way.

The government plans to build nine stations with a total installed capacity of 8.56 million kilowatts on the Wu Jiang which reportedly has a flow equalling that of the Yellow River, even though it is much shorter.

According to the plan, Dongfeng and Wujiangdu, the first one on the river with an installed capacity of 630,000 kW, will be operated by the company.

Dongfeng director Li Ziquan said that the revenue from the plant will be able to pay off all the investment which is about 2.2 billion yuan (\$254 million) within four years of its operation.

Li said the money will be used for building a third station, Honjiadu, on the river which will have an installed capacity of 540,000 kW. Its construction, which has been approved by the government, may start next year.

#### Developing the Hydropower Resources of the Jinsha Jiang

946B0112E Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 14 Jun 94 p 2

[Article by Li Zhengjie [2621 2973 2638], Xinhua News Agency]

[FBIS Translated Text] A team of electric power experts, led by CPPCC Vice Chairman Qian Zhengying [6929 2973 5391], together with local officials such as Vice Governor Niu Shaoyao [3662 4801 1031] of Yunnan and Vice Governor Ma Lin [7456 7792] of Sichuan, recently conducted a site survey along the Jinsha Jiang and a consensus was reached.

The Jinsha Jiang is the mainstream of the upper reaches of the Chang Jiang that flows from Yushu, Qinghai, to Yibin, Sichuan. It is 2,290 kilometers long and its basin covers 500,000 square kilometers. This corresponds to 27 percent of the basin area along the entire length of the Chang Jiang and is approximately one-half of the area upstream from the Three Gorges. The Jinsha Jiang has a huge natural drop of 3,281 meters. It contains an enormous amount of energy. The mean multi-year annual flow is 155 billion cubic meters, which is 16 percent of the total flow of the Chang Jiang. The upper reaches of the Jinsha Jiang flow through Qinghai, Xizang, Yunnan, and Sichuan, the middle section is mostly in Yunnan, and the lower part is essentially the border between Yunnan and Sichuan. This survey was focused on two dam sites at Luoxidu and Xiangjiaba along the border of Yunnan and Sichuan in the lower section of the Jinsha Jiang. Issues related to the construction of power stations were discussed.

According to our plan, a series of 19 power stations can be constructed along the Jinsha Jiang with a total of 75.12 million kW of installed capacity and capable of generating 362.7 billion kWh of electricity annually. It

has very attractive economic indicators, including construction costs, flooding losses and population relocation. It is a unique hydropower base. Particularly, the two power stations at Xiluodu and Xiangjiaba can accommodate 12 and 5 billion kW, respectively, in the initial stage. Eventually, their capacities will reach 15 and 7 million kW, respectively.

As a result of this survey and with sufficient proof, the experts believe that it is politically and economically important to accelerate the pace of development along the Jinsha Jiang so that the construction of the two major power plants at Xiluodu and Xiangjiaba can start immediately.

To construct the Jinsha Jiang hydropower base can consolidate the development of hydropower resources and other natural resources in the southwest in order to improve its industrial structure and layout and to develop its chemical, metallurgy and building material industry to support the national economy. Furthermore, the Jinsha Jiang basin is the home of people from many different ethnic backgrounds. The development of hydropower will effectively drive up the economy in the region. This will also help enhance our national unity.

Another significant factor associated with the development of the Jinsha Jiang is that it is an environmental shield for the Chang Jiang. It can enhance the flood control capability of the Chang Jiang, reduce the amount of silt entering the Three Gorges, improve navigation conditions and expand the acreage of farmland to be irrigated by the Chang Jiang. The development of the Jinsha Jiang will play an important role in blocking silt from piling up the reservoirs in the Three Gorges.

From the viewpoint of development conditions, a great deal of early stage work has been done by our planning, survey and design departments, particularly with reference to the two power plants at Xiluodu and Xiangjiaba. Both Yunnan and Sichuan expressed their desire to proceed. The Three Gorges Development Corporation and electric utilities in central and eastern China are also willing to participate in the development of the Jinsha Jiang. The experts believed that we should conduct early stage preparation work thoroughly to create the necessity for the development of the Jinsha Jiang and actively try to raise the necessary capital based on market economy principles. Policies should be drafted to facilitate the development of the Jinsha Jiang before 2000, to begin delivering electricity to the east by 2010 and to complete the construction of the Jinsha Jiang hydropower base by 2040.

#### **Accelerating Development of Jinsha Jiang Basin Hydropower Resources**

946B0115A Chengdu SICHUAN RIBAO in Chinese  
18 May 94 p 1

[FBIS Translated Text] From 7 to 13 May, the Jinsha Jiang Inspection Team, led by Qian Zhengying, Vice Chairman of the CPPCC, conducted its investigation of the hydropower development conditions on the lower reaches of the Jinsha Jiang in the Sichuan-Yunnan

border area. Accompanying Vice Chairman Qian Zhengying in the investigation were Vice Chairman of China International Engineering Consulting Corporation, Luo Xibei; Yunnan Vice Governor, Niu Shaoyao; Sichuan Vice Governor, Ma Lin; and Vice Chairman of the Sichuan CPPCC Provincial Committee, Xin Wen.

The hydropower reserves on the mainstream and tributaries of the Jinsha Jiang, which theoretically are up to 113,000MW, one-sixth the total reserves of the whole country, are largely concentrated in the lower reaches of the Jinsha Jiang (Panzhihua to Yibin), and the four cascade stations to be built between Xiluodu and Jiaba will have a total installed capacity of 29,000MW and an annual output of 151.58 billion kWh.

From 7 to 13 May, Qian Zhengying trekked over 1,500 kilometers along the banks of the Jinsha Jiang, observing the superlative hydropower advantages of its watershed basin, listening to the yearnings of the local Sichuan and Yunnan people for its development, and gaining an appreciation for the heroic efforts and marvelous accomplishments of the technicians from the Chengdu Survey Academy and Southwest Engineering Academy who are engaged in the early-stage work for opening up the Jinsha Jiang.

In the areas of the borders between Leibo County in Sichuan and Yongshan County in Yunnan, and between Pingshan County in Sichuan and Shuifu County in Yunnan, Qian Zhengying and the experts inspected the hydropower dam sites from Xiluodu to Jiaba, and along the way he also checked out the Xichang satellite launch base, the Liangshan Zhou bridge and reservoir, and the Huangtongzhuang power plant at Yibin.

On 14 May, at the Jinniu Guest House in Chengdu, Qian Zhengying, Vice Chairman Luo Xibei, and the experts joined in the studies on the early-stage work for the Jinsha Jiang hydropower development and the "send western electricity to the east" project, heard reports from all sides, and exchanged ideas on the construction of the hydropower stations from Xiluodu to Jiaba. Qian Zhengying said a lot was gained from the Jinsha Jiang inspection. The aim of the inspection was to see how to expedite the development of the Jinsha Jiang in retrospect of the Three Gorges project, making the Three Gorges project the takeoff point for Jinsha Jiang. Eastern, central and western participants need to be cooperatively engaged for a smooth and sustained overall development of the Jinsha Jiang Basin.

#### **Construction Progressing Quickly on Daxia Hydropower Station**

946B0141B Lanzhou GANSU RIBAO in Chinese  
4 Jul 94 p 1

[Article by reporter Yan Ming [0917 2494]]

[FBIS Translated Text] Phase two of Gansu's key construction project, the Daxia hydropower station on the Huang He, is proceeding smoothly; 70 percent of the excavation and filling work is finished, and the pouring of concrete for the dam formally begun on 28 June.



The important task in the early stage of phase two is to build the big river-bed dam, and excavating the foundation pit is a key part of that. In order to guarantee a full period of construction, the engineering directorate applied itself to managing the target schedule for the flood prevention functions, and in the first half of this year attention was focused on excavating the foundation pit needed to guarantee the flood prevention measures. By the end of June, 340,000 cubic meters of earth had been moved, and the bottom of the bowl-shaped pit was nearing the foundation rock face. The foundation pit for the big dam, sunk dozens of meters into the river bed, is critical to effective flood prevention. The surrounding dikes upstream and downstream, raised to heights of 1,467 and 1,458 meters above sea level respectively, can hold back 5,000m<sup>3</sup>/c of flood waters. Other high-water measures have been put into effect to assure smooth progress in the construction of the hydropower station.

#### **Newly Added Hydropower Capacity Sets Record**

94P60357 Kunming YUNNAN RIBAO in Chinese  
6 Jul 94 p 6

[FBIS Translated Text] Beijing, 1 July—The Ministry of Power Industry has disclosed that with the commissioning of the No. 3 generator at the Yantan hydropower station in Guangxi ahead of schedule, the nation succeeded in putting nine hydropower units into operation in the first half of 1994. These nine units represent a total installed capacity of 1.5445 million kW, a record for hydropower construction in this length of time.

This year, the State plans to put 15 hydropower units into operation for a total installed capacity of 2.8675 million kW—a record year for the installation of hydropower capacity.

The nine new units include Yantan in Guangxi, Manwan in Yunnan, Geheyan in Hubei, Daguangba in Hainan (two units), Shuikou and Oingxi (two units) in Fujian, and the Guangzhou pumped-storage hydropower station. In addition, work is progressing smoothly on six more units and experts from the Ministry of Power Industry expect that these will be commissioned before the end of the year.

#### **Electricity Output Rises Sharply in First Quarter**

40100053A Beijing CHINA DAILY (BUSINESS WEEKLY) in English 18 Apr 94 p 1

[Article by Wei Min]

[FBIS Transcribed Text] Production of electricity in the first three months of this year grew by a wide

margin over the same period last year and exceeded the government's quarterly target.

Latest statistics from the Ministry of Power Industry say 211 billion kilowatt-hours were generated in the first three months, a rise of 10.33 percent, higher than the growth in all of last year.

This means that 23.7 percent of the year's target of 890 billion kilowatt-hours has been met, far above the quarterly goal of 20 percent.

Of the power produced, 27.5 billion kilowatt-hours came from hydroelectric plants, up 20.1 percent, and 182.2 billion kilowatt-hours from thermal plants, up 8.36 percent. Government plans call for 146 billion kilowatt-hours from hydroelectric plants in the whole year and 736 billion kilowatt-hours from thermal power stations.

Nuclear power provided 1.18 billion kilowatt-hours, 10 times more than a year earlier.

Power grids grew faster than the national average of 10.3 percent in the East China region; the provinces of Fujian, Guangdong, Henan, Sichuan, Guizhou and Yunnan, and Guangxi Zhuang Autonomous Region. But five other grids—in Shandong Province and the northern, northeastern, central and northwestern regions—were below the average.

The remarkable growth in hydroelectric production was attributed to full reservoirs and recent completion of a number of power stations.

The hydroelectric expansion was fastest in the power grids of East China, Guangxi and Fujian, Sichuan, Guizhou and Yunnan.

The greatest growth was in Yunnan, 72 percent. However, production in drought-stricken northeastern provinces was 22 percent below the same period last year.

The 10 million tons of coal stored at thermal plants at the end of March was considered enough to maintain production.

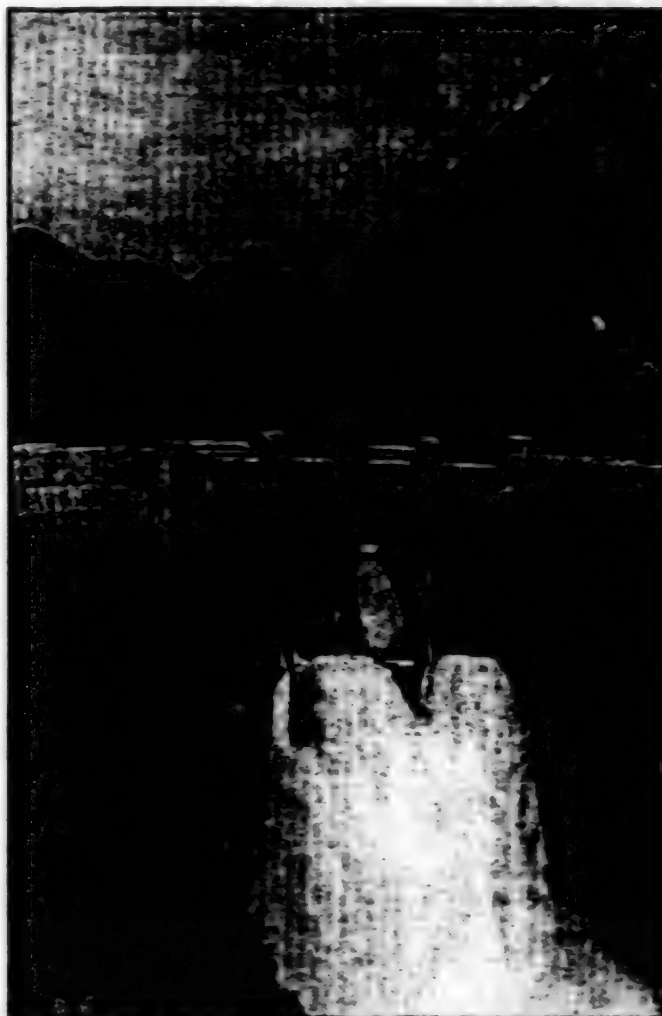
However, the statistics indicate problems arising from the reform of coal pricing and the adoption of new accounting methods for deals among power plants, coal mines and electricity consumers.

Measures to solve the problems will be implemented in the next several months.

Officials from the Ministry of Power Industry pointed out that the growth in installed generating capacity still lags behind industrial production because of the shortage of capital.

**Guizhou's 75,000-kW Puding Station Has World's Tallest Rolled Concrete Arch Dam***94P60380A Lanzhou GANSU RIBAO in Chinese 9 Aug 94 p 2*

[FBIS Translated Text]



China's first all-sectional rolled concrete arch dam—the 75-meter-high dam for the Puding hydroelectric station in Guizhou—has recently been completed. The construction was handled by the 8th Water Conservancy and Hydroelectric Power Engineering Bureau. The station, which will be equipped with three 25,000-kW generating units, has the tallest dam of any comparable type station in the world today.

**'Big Breakthroughs' Expected in Foreign Investment in Power Sector***40100053B Beijing CHINA DAILY  
(BUSINESS WEEKLY) in English  
18 Apr 94 p 1*

[Article by Chang Weimin: "Powerful Priority"]

[FBIS Transcribed Text] China is to target financial transnationals for capital to beef up its overburdened power sector to break the economic "bottleneck" hindering development.

The country, which has suffered shortages of electricity for two decades, expects at least \$25 billion to be invested in the sector in the next seven years.

Delegations will be sent to Western nations this year with proposals for cooperation, said an official with the Ministry of Power Industry.

Power production has become a key attraction for foreign investors over the past two years and several overseas-financed power plants have been announced.

"Big breakthroughs in foreign investment are expected," the official, who declined to be identified, said in an interview with BUSINESS WEEKLY last week.

China can produce up to 181 million kilowatts. Experts estimate that 25 percent more capacity is needed to satisfy the booming demand.

Power Industry Minister Shi Dazhen last week began a 17-day trip to France, Spain and Israel to bring in investment.

China expects 9 percent economic growth for the next seven years. To achieve that goal, additional generating capacity of at least 120 million kilowatts must be installed by the year 2000.

That means an average 17 million kilowatts of generators should be installed each year.

The government plans 12 million kilowatts for this year but financing has not been fully arranged. Some 10 billion yuan (\$1.15 billion) of the 66 billion yuan (\$7.6 billion) needed is not available.

Ministry officials said the capital shortage will probably be eased later this year as the central government gives the sector top priority and the new State Development Bank begins supporting construction of infrastructure.

But they pointed out that bigger problems lie ahead. Fewer projects were kicked off last year than were expected and no projects have been approved so far this year. Big power plants that are planned may not be completed, they said.

This scaled-down construction, they caution, would jeopardize long-term economic growth.

The government does not want to let big capital construction projects drive up inflation, which in the first two months of the year stood at 20 percent. Building a large power plant requires billions of yuan.

Plants with total capacity of 53 million kilowatts are under construction, but that is at least 7 million kilowatts less than expected.

At the same time last year, 54 million kilowatts were under construction.

Officials warn that if enough investment is not found, construction would further shrink.

In France, Shi is expected to sign an agreement with the French power sector to extend a 10-year power cooperation treaty that expires this year.

The minister, leading five key officials from the ministry, is to explain China's energy policies to the French Government and business community, discuss possibilities for further cooperation, and learn about French corporate management.

Coming on the heels of French Prime Minister Edouard Balladur's visit to China, the mission is expected to be fruitful, trade analysts said.

Balladur's visit was described as a turning point, following about four years of relatively cool relations between the two countries.

Shi's visits to Spain and Israel are also considered important. A Western European power union is based in Spain, and Israel has ties with financial organizations worldwide.

China is also to rely on foreign power groups for know-how to improve its efficiency.

The Ministry of Power Industry said late last year that China would need \$25 billion in foreign investment by the year 2000 to generate enough electricity to support its economy.

#### **Computerized Cable Hoist Concrete Pouring System for Use on High Dams**

946B0122C Guiyang GUIZHOU RIBAO in Chinese  
4 Apr 94 p 2

[Article by Zhou Zimu [0719 1311 3664]: "Successful Test of a Computerized Cable Hoist System on the Dongfeng Power Plant Construction Site"]

[FBIS Translated Text] A microcomputer-controlled cable hoist system, the subject of an S&T project for the Eighth 5-Year Plan that was undertaken by the No. 9 Hydropower Office and was completed over a period of two years with the cooperation of the Gezhouba Power Plant's research institute, was recently successful in concrete-pouring tests at the Dongfeng power plant construction project. The development of this system represents a new level in Chinese-developed rapid hydroelectric dam construction technology. The high arch dams for hydroelectric plants are usually built in mountain gorges. Cable hoists are the main devices for vertical movement in the concrete pouring process. The progress of dam construction is directly dependent on their productivity and efficiency. The development of a microcomputer-controlled cable hoist for concrete pouring allows the concrete to be poured at a designated location and a television system can be used to monitor the hoisting and pouring operations. This solves a key technical problem in the use of cable hoists to pour concrete on extremely high arched dams. The pouring of the concrete at a designated location is made possible by a computer, which makes calculations and issues commands. The system also includes remote control equipment, allowing monitoring of the hoist from the cabin and automatic pouring of its contents. This speeds up



cable hoist operation greatly and improves productivity. The computerized control system is simple to operate, free of operator error, and safe and reliable. The system was tested in the pouring of concrete at the main dam of the Dongfeng hydroelectric station on 21 and 24 March. The performance characteristics were as planned and the expected results were obtained.

### Thermal Power

#### Yuanbaoshan Plant Update

946B0129C Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 25 Jun 94 p 2

[Article by Gao Qingming [7559 3237 2494] and Sun Jipeng [1327 4949 7720]]

[FBIS Translated Text] Construction Bank of Chifeng, Inner Mongolia, is collecting funds for electric power construction projects, and this year it has made available 210 million yuan for the third-stage construction project of the Yuanbaoshan power plant.

Yuanbaoshan, the largest thermal power plant in north-east China, is located in the Yuanbaoshan district of Chifeng. Construction of this 2,100MW (installed capacity) plant began in 1975 under a total investment of 4.41 billion yuan.

To ensure smooth progress of its construction, the Chifeng Construction Bank set up a special funding service organization at the plant—the Construction Bank Yuanbaoshan Power Plant Special Branch Bank.

#### Siemens To Help Build Hebei Power Plant

946B0148A Shijiazhuang HEBEI RIBAO in Chinese 27 Jun 94 p 1

[Article by Wang Baoyuan [3769 1405 0337] and Zhang Jingjing [1728 6602 1906]]

[FBIS Translated Text] After three days of evaluation and deliberation by more than 200 experts from 41 units, the feasibility study report for the phase I construction of the Hanfeng power plant was approved on 25 June in Handan.

The planning of the Hanfeng power plant began in 1979. A special organization was formed in 1984 and the State Planning Commission formally approved the project in April last year. On 16 November, while German Prime Minister Kohl was visiting China, Hebei Province signed an agreement with Siemens of Germany in the Great Hall of the People, with Premier Li Peng and Prime Minister Kohl. The agreement was for a joint venture to build two 660,000-kW coal-burning electric generators. After the signing of the agreement, a great deal of human and material resources were devoted to the project by the ministers of the state, the provincial government, the provincial electric power bureau, Handan municipality and the Fengfeng mining region. A feasibility study

report was drafted by the Hebei provincial electric power survey and design institute. Experts believe that the Hanfeng electric power plant has superior conditions with respect to coal, water, ash, and transportation. The technological conditions are also mature. These advantages are the basis for the next step of design, construction, and installation.

The investment for the phase I construction of the Hanfeng project would be 10.4 billion yuan, with 40 percent of it coming from foreign investors. After the Hanfeng power plant is completed, it will have the largest single unit capacity in Hebei.

#### Henan Formulates Plan for Small-Scale Thermal Power Development

946B0148B Zhengzhou HENAN RIBAO in Chinese 6 Jul 94 p 2

[Article by Yu Liankui [0060 6647 7608] and Hao Xincan [6786 1800 2088]]

[FBIS Translated Text] On an inspection tour in Henan, the Minister of the Power Industry stated that, "Development of small coal-fired power plants should be done with specific analysis; in principle, small coal-fired plants should not be built in regions without coal or regions to which coal must be imported."

Small coal-fired plants are enjoying rapid development in Henan because the province is rich in coal and suffers a shortage of electric power. As of the end of 1993, nearly one-half of the 118 counties and cities in Henan had small coal-fired electric power plants, with the total number exceeding 100 and the total capacity exceeding 2.3 million kW. Small coal-fired plants account for 28 percent of Henan's electric power generation capacity; this percentage is much higher than the national average. According to incomplete statistical data, another 36 small coal-fired power plants are under development, with about one-third of them already in operation. Small coal-fired power plants are mushrooming in China, some regions even built small coal-fired power plants near large electric power plants.

In order to implement the national energy policy and to regulate the development of the power industry, the provincial planning committee and the provincial electric power bureau recently formulated opinions regarding the development of small coal-fired power plants. In future local power development, the policy is to build generators 100,000 kW or greater. Unless it is for heating purposes, 50,000-kW or smaller units should be avoided. Projects approved by the municipalities or regions may be implemented only after going through an evaluation process by a qualified consulting unit. Such projects must also be reported to the provincial planning committee and the provincial electric power bureau. In the development of the small coal-fired power plants, consideration should be given to the needs in regional

economic development. The electric power should be balanced locally. If it is difficult to balance the electric power locally, then a new project may be established, but only after obtaining written approval from the electric power bureau.

### **1.2 Million-kW Fuyang Project Passes Feasibility Examination**

946B0148D Hefei ANHUI RIBAO in Chinese 26 Jun 94 p 1

[Article by Shi Wanchun [0670 8001 2504] and Li Bao [2621 6283]]

[FBIS Translated Text] From 21-24 June, the feasibility study of the new Fuyang electric power project underwent evaluation conducted by the Electric Power Planning Institute of the Ministry of Power Industry.

One hundred and twenty-eight experts and scholars from 40 some units in Beijing, Shanghai, and Hefei have made on-site inspections and repeatedly deliberated the plant site, the water supply, the dedicated railroad, and the ash storage field. They unanimously agreed that Fuyang has the attributes for building a large power facility. It has ample water supplies and well-developed railroads. It is located strategically where the coal from the north is transported to the south, and it has a sound plant zone and ash storage field. It could become a pivotal power plant. After evaluation, the feasibility report, proposed by the Anhui Electric Power Design Institute with consultation from the Southwest Electric Power Design Institute, was approved.

The Fuyang power facility is designed to be a 1.2 million-kW project requiring an investment of 4 billion yuan. Fuyang is one of eight electric power shortage areas in China. The annual per capita electric power consumption in Fuyang region is far below the national average and the provincial average in Anhui. This shortage has severely impeded the economic development of the region. The local authority therefore made a decision to build a large power facility. The preparatory phase of the project is progressing nicely.

### **Work Completed on 250MW Weihai Plant in Shandong**

94P60349 Beijing RENMIN RIBAO in Chinese 18 Jul 94 p 1

[FBIS Translated Text] A few days ago, the second 125MW generator of the Shandong Huaneng Weihai power plant formally went into operation. A total investment of 895 million yuan has been made in this important national energy construction project. The plant has now been completely finished. Prior to this, the first 125MW generator had been operating smoothly for 230 days, producing some 600 million kWh of electricity.

### **Waigaoqiao Update**

94P60367 Shanghai WEN HUI BAO in Chinese 9 Aug 94 p 2

[FBIS Translated Text] Work has officially begun on Shanghai's Waigaoqiao thermal power plant, a major project under the State's 8th 5-Year Plan. The Shanghai Waigaoqiao power plant construction project was formally approved by the State Planning Commission as an 8th 5-Year Plan item in April 1990. The project is also the largest—in terms of investment—capital construction project in the Pudong New Zone. Phase 1 of this project calls for the installation of four 300MW coal-burning units that will be both domestically manufactured and imported. Phase 2 of the project will involve the installation of two 900MW units. Phase 3—now in the planning stage—calls for the installation of two 1000MW units for a total installed capacity of 5000MW.

### **Coal**

### **Coal Industry Eagerly Seeking Foreign Funding, Technology**

946B0112D Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 11 Jun 94 p 2

[Article by Gao Xinhua [7559 5281 5478], Xinhua News Agency]

[FBIS Translated Text] The coal industry has actively pursued and secured some foreign capital and advanced equipment and technology to construct and upgrade a number of mines to raise the level of mechanization and improve productivity.

According to an official of the Ministry of Coal Industry, a total of \$4 billion of foreign capital, including Japanese energy loans, World Bank loans, loans from the Swedish and Italian governments, and direct investments were made by foreign companies.

He pointed out that the Japanese energy loan is the major source of foreign funding for the coal industry. To date, three loans have been funded for mine construction and equipment purchase. A total production capacity of 38 million tons has been completed.

The coal industry began to seek foreign investment in 1982. Due to the fact that it is a long-term investment that requires a large sum of capital and produces a relatively low return, foreign funding in the coal industry is subject to government regulation. Ministry of Coal Industry officials welcome foreign involvement in the coal industry, including construction of coal mines, pit-mouth power plants, coal gas plants, cement factories, and coal pipelines.

The Ministry of Coal Industry believes that this would improve the product structure of the industry. Vice Minister Han Ying [7281 5391] pointed out that the government has limited resources to invest in coal mines

and it is impossible to invest a large sum of money in power plant construction. Hence, it is appropriate to attract foreign funding to complete such projects.

Projects funded by foreign investors at the Yima coal gas plant in Henan are near completion. Negotiations are under way with foreign investors for the strip mine and power plant at Haerwusu in Jungar, the coal gas pipeline between Mengxian, Shanxi to Weifang, Shandong, and the pit-mouth power plant at the Wuda mine in Inner Mongolia. Some of them have signed letters of content.

The coal industry got an early start in importing equipment and technology. In the early 1970s, full-scale mechanized coal mining did not exist in China. Since then, more than 200 sets of equipment have been imported from west and east European countries. From the 1980s on, by way of imported technology and equipment, the level of mechanization has been raised even more.

Today, imported coal mining machines, excavation machines, auxiliary mine shaft transport equipment, hydraulic support and high power transport machines are widely used in all mines. Key coal mines in China are 72 percent mechanized. Overall, 44 percent of the coal mining process is automated.

In the Eighth 5-Year Plan (1991-1995), additional equipment and technology will be imported on a large scale to further improve coal production in China.

China produced 1.14 billion tons of coal last year, which ranks number one in the world. It is projected to reach 1.4 billion tons in 2000. This will represent 69 percent of our primary energy supply.

The Ministry of Coal Industry is intensifying its effort to encourage foreign investment. It plans to hold a meeting to attract foreign investment in the coal industry in the Fall. It indicates that all possible conduits will be opened to attract foreign investment in order to enhance its capability to obtain funding for further growth.

#### **Coal Resources, Coal Properties, and Rational Coal Production and Consumption in Northeast China Analyzed**

946B0130A Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese Vol 22 No 5, May 94 pp 37-40

[Article by Li Wenhua [2621 2429 5478], Beijing Institute of Coal Chemistry, Academy of Coal Science, and Qu Jiong [4234 3518], Computation Center, Academy of Coal Science: "Coal Resources and Coal Characteristics and Rational Coal Development and Utilization in Northeast China"]

[FBIS Translated Text]

#### **I. Characteristics of Northeast China's Coal Resources**

Several decades of geological exploration have given us a rather clear understanding of the coal resources of

Northeast China and the distribution of coal fields there. Northeast China's coal resources are relatively small, amounting to only about 3 percent of the country's total reserves. The principal types of coal in these limited reserves are brown coal and long flame coal, which together account for 50.74 percent of the total. Coking coal is also rather well represented, but most of it is gas coal; superior coking coals, such as rich coal, coking coal proper, and lean coal are rather uncommon. Superior smokeless coal is also scarce.

The distribution of coal fields in Northeast China is rather uneven: they occur chiefly in northeastern Heilongjiang and western Liaoning. The rate of utilization of coal reserves in the three provinces of the northeast is high, exceeding 50 percent in Liaoning and Jilin, and there is very little underground coal, so that the area is highly deficient in coal reserves. Coal consumption in Northeast China greatly exceeds the region's coal output. Liaoning and Jilin require large shipments from outside the area every year. The total amount of coal transported into Northeast China annually is about 30.89 million tons.

The need to transport this amount of coal not only imposes a great burden on the railroads, but also constrains the area's industrial development. In addition, the development of Northeast China's coal fields began rather early, and there are now many old and declining coal mines; thus there is little untapped potential for increasing the region's coal output.

#### **2. Quality Characteristics of Northeast China's Coal**

The quality of coal directly affects its processing and utilization. A macroscopic understanding of the quality characteristics of Northeast China's coal will provide important guidance in drafting coal development policies and processing and utilization programs for the region. The ash content, sulfur content, and calorific value are three of the most important characteristics of coal, which have the key influence on its utilization.

##### **2.1. Ash Content of Northeast China's Coal**

The percentages of total coal reserves and of total coal sales in Northeast China are plotted against the ash content of the coal, in 1 percent increments, in Figs. 1 and 2. The abscissa gives the ash content and the ordinate the percentage of total coal reserves or total commodity coal. These plots show the pattern of coal reserves and coal sales and Northeast China: they can be used to determine the percentage of coal reserves or commodity coal having a given ash content.

The weighted mean ash content of Northeast China's coal reserves is 21.65 percent, and the mean ash content of the region's commodity coal is 23.22 percent. Both figures are significantly higher than the national average: the region's coal can be classified as having moderate ash content. It is evident from the figures and from Table 1 that both the region's coal reserves and its commodity



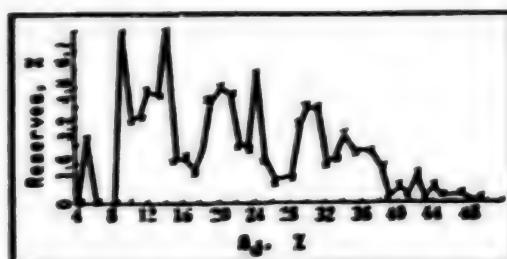
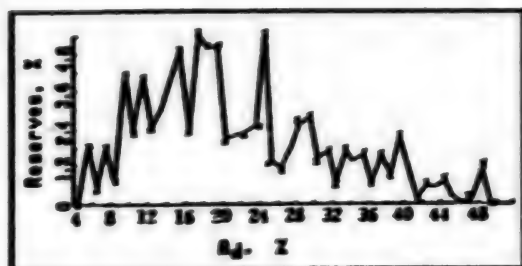


Table 1. Distribution of Ash Content in Coal of Northeast China

	Ash content						Weighted mean (%)
	Very low ≤ 5.00	Low 5.01-10.00%	Low to moderate 10.01-20.00%	Moderate 20.01-30.00%	Moderate to high 30.01-40.00%	High 40.01-50.00%	
Coal reserves	0.09	10.17	40.33	26.79	14.71	4.07	21.65
Coal sales	2.65	6.94	34.48	27.90	22.87	3.72	23.22

Note: Ash content ranges are taken from state standard "Ash Content Ranges of Coal" (draft, approval pending).

coal are predominantly of low-to-moderate and moderate ash content. But moderate-ash coal represents a significant part of all commodity coal, while very little commodity coal is low-ash coal.

## 2.2. Sulfur Content of Northeast China's Coal

Northeast China's coal reserves and coal sales are plotted against the sulfur content of the coal in Figs. 3 and 4: the abscissa represents the total sulfur content, in 0.20 percent increments, and the ordinate represents the percentage of total coal reserves or total coal sales having a given sulfur content.

The mean sulfur content of Northeast China's coal reserves is 0.47 percent and the mean sulfur content of the region's commodity coal is 0.50 percent. Both figures are significantly lower than the national average, and the

coal belongs to the extremely low sulfur category. It is evident from the figures and from Table 2 that both the region's coal resources and its commodity coal are chiefly of the very low sulfur type; the other sulfur-content categories are of minor importance. Northeast China is one of the areas of the country with the lowest-sulfur coal.

## 2.3. Calorific Value of Northeast China's Coal

In Figs. 5 and 6, coal reserves and coal sales in Northeast China are plotted against the calorific value of the coal, in 0.50 MJ/kg increments. The abscissa in Fig. 5 represents dried ash-free coal of high calorific value, and that in Fig. 6 represents coal of low calorific value; the ordinates are respectively the percentage of coal reserves and the percentage of coal sales associated with each calorific value.

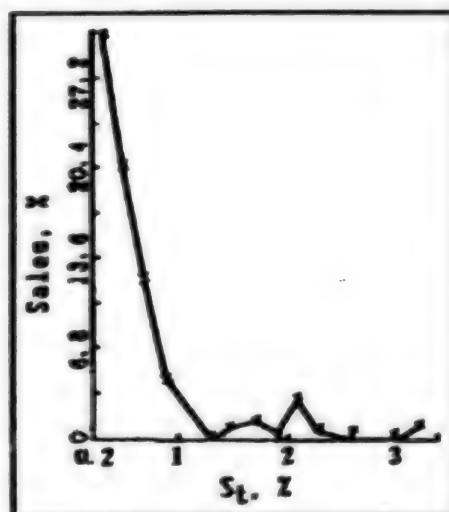
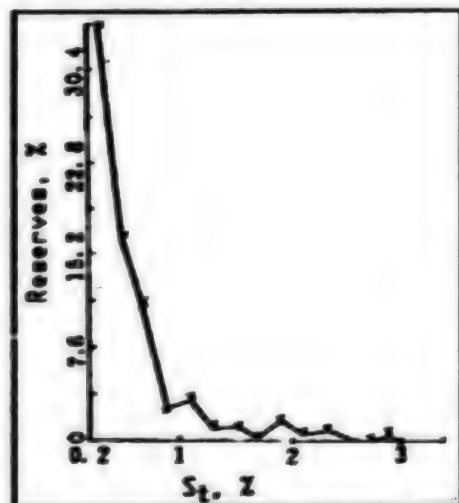


Table 2. Distribution of Sulfur Content in Coal of Northeast China

	Sulfur content						Weighted mean (%)
	Extremely low ≤ 0.50%	Low 0.51-1.00%	Low to moderate 1.01-1.50%	Moderate 1.51-2.00%	Moderate to high 2.01-3.00%	High >3.00%	
Coal reserves	51.66	14.84	5.72	1.92	2.05	0.00	0.47
Coal sales	50.68	16.61	3.29	2.15	3.87	0.95	0.50

Note: Sulfur content ranges are taken from state standard "Sulfur Content Ranges of Coal" (draft, approval pending).

The average calorific content of Northeast China's coal ( $Q_{gr,ad}$ ) is 33.10 MJ/kg, less than the national average. The average calorific value of commodity coal ( $Q_{net,ar}$ ) is 21.70 MJ/kg, considerably lower than the national average of 23.40 MJ/kg (see Table 3).

The data on ash content, sulfur content and calorific value presented above indicate that Northeast China's coal can be generally characterized as having high ash content, low sulfur content, and low calorific value.

#### 2.4. Quality of Northeast China's Commodity Coal

China has issued many industrial coal quality standards. These standards differ in the requirements that they

impose. The extent to which Northeast China's commodity coal satisfies the requirements of particular standards is well worth considering, and it also is an indication of the overall quality of the region's commodity coal. It will be seen from Table 4 that the ash content, total sulfur content, and calorific value of most of Northeast China's commodity coals meet the requirements of the standards.

#### 3. Rational Development and Utilization of Northeast China's Coal Resources

To assure that Northeast China's limited coal resources are rationally developed and utilized and to guarantee the rapid and stable development of the region's industry, a long-term program for the development and utilization of coal resources and appropriate policies, geared to the nature and quality of the region's coal resources, must be pursued.

The existence of many old and declining coal mines in Northeast China makes it difficult to increase coal output further. In addition, owing to the relative scarcity of coal resources, the construction of large numbers of new coal mines is also unrealistic. Under current conditions, we must vigorously pursue advanced technologies, tighten management, increase recovery rates, decrease losses in coal extraction, lengthen the operating life of coal mines, and assure that the coal output of some of the mines is relatively stable.

The supply of coking coal in Northeast China is not large, but it is heavily mined: coking coal accounts for about 50 percent of the region's coal output. But only 50 percent of the output of coking coal is washed to produce fine metallurgical grade coal; the rest is burned to produce power, which is a serious waste of resources. Thus, the extraction of coking coal in the region should be geared to needs, both assuring rational utilization of coal resources and protecting the valuable resources of coking coal. A high ash content is one of the main

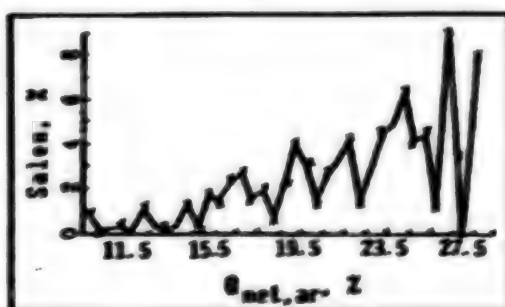
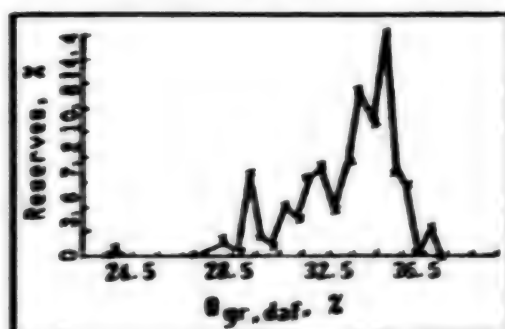


Table 3. Distribution of Calorific Value in Coal of Northeast China

	Calorific value (MJ/kg)						Weighted mean
	Low 8.50-12.50	Low to moderate 12.51-17.00	Moderate 17.01-21.00	Moderate to high 21.01-24.00	High 24.01-27.00	Very high >27.00	
Coal sales	2.06	11.26	19.51	23.50	31.73	8.75	21.70

Note: Calorific value ranges are taken from state standard "Calorific Content Ranges of Coal" (draft, approval pending).

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Table 4. Satisfaction of Standards by Commodity Coal of Northeast China

Name of standard	Grade	Percentage of commodity coal meeting standard		
		Ash content	Sulfur content	Calorific value
GB697: Metallurgical coking coal	1	9.50	70.58	—
	2	11.64	5.97	—
Coking Coal for Casting	1	9.50	67.29	—
	2	—	3.29	—
Smokeless Coal for Blast Furnace Injection	1	2.65	50.68	—
	2	10.35	16.61	—
	3	12.09	—	—
	4	10.71	—	—
GB 9143: Coal for Normal-Pressure Stationary Coal-Gas Generating Furnaces	1	37.64	72.73	—
	2	21.60	—	—
GB 7561: Coal for Synthetic Ammonia Production	1	39.12	50.68	—
	2	9.49	16.61	—
	3	14.57	5.44	—
GB 7562: Powdered Coal for Power-Plant Boilers	1	62.86	67.29	63.96
	2	24.74	9.31	78.80
	3	13.33	—	86.48
	4	—	—	90.50
	5	—	—	95.91
GB 7563: Coal for Rotary Cement Kilns	1	66.60	76.60	63.96
GB 4063: Coal for Steam Locomotives	1	62.86	67.29	12.96
	2	—	—	22.03
	3	—	—	28.79

characteristics of Northeast China's coal. From an integrated viewpoint that includes conservation of power and protection of the environment, a higher percentage of power coal should be washed in order to improve its quality. For the long term, in order to deal with Northeast China's inadequate coal supply, the state should rapidly develop several large coal fields in Nei Mongol, which is adjacent to Northeast China, in order to end the region's coal shortage.

#### Superclean Coal Research and Development

946891308 Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese Vol 22 No 6, Jun 94 pp 40-42

[Article by Chen Wenmin [7115 2429 2404], Beijing Institute of Coal Chemistry, Academy of Coal Science: "Development of Superclean Coal in China"]

[FBI5 Translated Text]

#### Abstract

The results of experiments on the development of superclean coal in China are described. In small-scale laboratory experiments, treatment of various coal grades with hydrochloric acid and then with hydrofluoric acid yielded superclean coal with an ash content between 0.26 and 0.8 percent. Physical concentration by repeated washing produced superlow-ash fine coal with an ash content of about 1.6 percent. Both of these methods have development potential.

Starting in the mid-1960s, efforts were made in Australia, Japan, the United States, Germany and elsewhere to develop a new type of solid fuel, superclean coal. In 1979, an ash removal technique consisting of treatment with hydrofluoric acid supplemented by treatment with acidified ammonium fluoride was developed in Australia, Japan, and elsewhere. In the mid-1980s, a combination of physical concentration and chemical treatment was used in the United States to produce superclean coal with an ash content below 0.5 percent, which has the potential to replace diesel fuel for use in internal combustion engines and gas turbines. Since the mid-1980s,

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Table 1. Industrial Characteristics of Raw Coals

Source and type	M <sub>ad</sub> , %	A <sub>d</sub> , %	V <sub>daf</sub> , %	CRC	S <sub>t,d</sub> , %	Q <sub>gr,daf</sub> , MJ/kg
Yanzhou gas coal	2.92	6.66	36.72	4	0.31	33.32
Dongsheng non-caking coal	5.96	6.25	32.02	1	0.37	31.65
Rujigou smokeless coal	1.27	10.66	8.81	1	0.19	35.72
Lingwu non-caking coal	10.77	8.25	30.88	1	0.55	30.08
Xinmi lean coal	1.24	17.31	13.49	1	0.35	35.20

experimental studies of superclean coal have been undertaken in China, and superclean coal with an ash content as low as 0.26 percent to 0.8 percent and a sulfur content as low as 0.14 percent to 0.51 percent have been produced.

#### 1. Main Characteristics of Starting Materials Used in the Preparation of Superclean Coal

The Beijing Institute of Coal Chemistry, Academy of Coal Science, has investigated the preparation of superclean coal from various grades of power-production coal. The sites from which the coal specimens were selected, and the industrial analyses and elementary analyses of the coal, are given in Tables 1-3.

It is evident from the results that Rujigou coal and Xinmi coal have a rather high content of clay minerals and also contain some carbonate minerals. On microscopic inspection it was found that calcite in Rujigou coal occurs primarily as filling in cracks and cells, and that much of it occurs in intergrowth with clay minerals. In the Xinmi coal, the principal minerals are fine particulate clay minerals, together with calcite as filling in cracks. In Yanzhou coal the primary minerals are clay minerals, calcite and pyrite; the latter two minerals partially occur in cell cavities in the fibrous mass of the coal. Dongsheng coal has a rather high carbonate content; the main carbonate minerals present are calcite and siderite. Minerals in the resolved state such as calcite are rather abundant, occurring as large particles. Lingwu

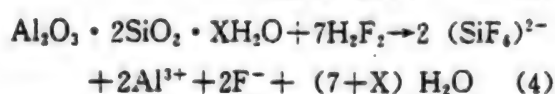
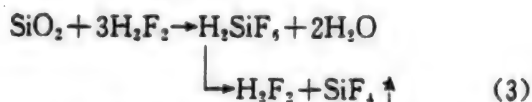
coal has a high content of fibrous matter; the principal minerals present are clay minerals and carbonate minerals, which occur in cell cavities.

#### 2. Mechanism and Technique of the Preparation of Superclean Coal

Superclean coal is prepared by treating it with hydrochloric acid, which removes the carbonates, most of the sulfates, and some sulfides. The reactions involved are:



Hydrochloric acid treatment removes most of the ash. Hydrofluoric acid is then used to remove clay minerals, quartz, and other silicon-containing minerals. Some of the reactions involved are:



A series of experiments studying the effect of pH, pressure, and length of treatment on the reaction of coal

Table 2. Elementary Analyses of Raw Coals

Source	C <sub>daf</sub> , %	H <sub>daf</sub> , %	N <sub>daf</sub> , %	O <sub>daf</sub> , %	S <sub>daf</sub> , %	P <sub>d</sub> , %	Cl <sub>d</sub> , %
Yanzhou	83.49	4.95	1.54	9.71	0.33	0.00986	0.000
Dongsheng	82.48	4.17	0.83	12.12	0.40	0.00329	0.000
Rujigou	93.66	3.31	0.77	2.04	0.22	0.00729	0.0070
Lingwu	81.12	3.57	0.77	13.94	0.60	0.00381	0.0123
Xinmi	90.00	4.00	1.53	3.67	0.41	0.01236	0.0303

Table 3. Microscopic Characteristics of Coals

Source and type of coal	Organic components, %					Inorganic components, %					$\overline{R}_0$ , %
	V	SV	SF + F	S	OM	K <sub>1</sub>	K <sub>2</sub>	K <sub>3</sub>	K <sub>4</sub>	K <sub>5</sub>	
Yanzhou gas coal	50.8	4.6	34.7	7.8		0.6	1.5	0	0	0	0.698
Dongsheng non-caking coal	36.7	7.9	52.5	1.5		0.3	1.0	0.1	0	0	0.605
Rujigou smokeless coal					94.0	4.1	1.9	0	0	0	2.508
Lingwu non-caking coal	15.5	3.7	77.7	1.2		0.6	1.9	0	0	0	0.475
Xinmi lean coal					92.0	7.5	0.5	0	0	0	2.128

Note: V, vitrain; SV, semivitrain; SF + F, semifusain and fusain; S, stable fraction; OM, organic matter; K<sub>1</sub>, clay; K<sub>2</sub>, carbonates; K<sub>3</sub>, sulfides; K<sub>4</sub>, oxides; K<sub>5</sub> other;  $\overline{R}_0$ , vitrinite reflectivity

samples with hydrochloric and hydrofluoric acids was used to choose the optimum conditions for the preparation of superclean coal. First, the raw coal was treated with a 1:1 hydrochloric acid solution (with solid and liquid in 1:5 proportions) for an hour. The hydrochloric acid was then filtered off and the coal was washed with water and transferred to a fluorocarbon container, where it was treated with boiling 1:1 hydrofluoric acid solution (solid and liquid in 1:5 proportions) for an hour. The solution was allowed to cool and was filtered, and the resulting superclean coal was washed. Finally, the coal was air-dried at 40° to 50°C.

### 3. Characteristics of the Superclean Coal

The ash content of the superclean coal produced by treatment with hydrochloric and hydrofluoric acids had decreased from an initial value of 6.5-17.31 percent to

0.26-0.81 percent (Tables 4 and 5), representing an ash reduction rate as high as 90 percent or more. But there was little reduction in sulfur content. Because the sulfur in low-sulfur coal occurs chiefly in organic compounds, it cannot be removed by acid treatment.

### 4. Removal of Impurities From Superclean Coal

After treatment with hydrochloric and hydrofluoric acids and washing, the coal still contained relatively large amounts of fluoride and chloride (Table 6); these impurities had to be removed in order for the process to be practicable. A variety of methods of removing chloride and fluoride were studied. It was found that distillation from a solution of boric acid in saturated hydrochloric acid was effective. The distillate was condensed and recovered in a separate container. The concentrations of fluoride in the original coal and the superclean coal after this treatment are shown in Table 7.

Table 4. Industrial Analyses of Superclean Coals

Mine	M <sub>ad</sub> (%)	A <sub>d</sub> (%)	V <sub>daf</sub> (%)	S <sub>t,d</sub> (%)	S <sub>gr,daf</sub> (MJ/kg)
Yanzhou	2.87	0.60	35.08	0.27	33.54
Dongsheng	4.81	0.80	30.47	0.29	31.38
Rujigou	1.18	0.26	6.94	0.14	35.91
Lingwu	7.24	0.56	29.41	0.51	29.69
Xinmi	1.46	0.59	10.31	0.39	36.04

Table 5. Elementary Analyses of Superclean Coals

Mine	C <sub>daf</sub> (%)	H <sub>daf</sub> (%)	N <sub>daf</sub> (%)	O <sub>daf</sub> (%)	F <sub>d</sub> (%)	Cl <sub>d</sub> (%)
Yanzhou	82.23	5.12	1.56	10.76	0.2678	0.205
Dongsheng	79.90	4.11	0.93	14.76	0.2198	0.142
Rujigou	92.56	3.45	0.83	3.02	0.2297	0.217
Lingwu	78.56	3.63	0.85	16.50	0.2587	0.181
Xinmi	91.85	3.77	1.48	2.51	0.4668	0.203

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Table 6. Amounts of Harmful Components in Coals

Mine	F <sub>ad</sub> (%)		Cl <sub>ad</sub> (%)	
	Raw coal	After HCl-HF treatment	Raw coal	After HCl-HF treatment
Yanzhou	0.0096	0.2601	0.0000000	0.0000199
Dongsheng	0.0031	0.2092	0.0000000	0.0000135
Rujigou	0.0072	0.2270	0.0000007	0.0000214
Lingwu	0.0034	0.2400	0.0000011	0.0000168
Xinmi	0.0128	0.4600	0.000003	0.00002

Table 7. Fluorine Content of Raw Coals and of Superclean Coals Before and After Treatment

Mine	F <sub>ad</sub> (%)		
	Raw coal	Superclean coal	Superclean coal after HCl-boric acid treatment
Yanzhou	0.0096	0.1120	0.0290
Dongsheng	0.0031	0.1060	0.0317
Rujigou	0.0072	0.0870	0.0250
Lingwu	0.0034	0.0530	0.0270
Xinwu	0.0128	0.1070	0.0230

It will be seen from the data that the treatment is capable of removing most of the residual fluoride, but the fluoride content still is higher than that of the raw coal. If it is desired to lower the fluoride content still further, the treatment may be repeated, but this will increase the cost. The residual concentrations of boron and chlorine after distillation with a solution of boric acid in saturated hydrochloric acid are shown in Table 8. Washing should greatly decrease the chloride content of the superclean coal.

Table 8. Boron and Fluorine Content of Superclean Coal After Treatment

Mine	B (%)	Cl (%)
Yanzhou	0.0572	0.11
Dongsheng	0.0315	0.11
Rujigou	0.0448	0.11
Lingwu	0.0195	0.08
Xinmi	0.0258	0.09

### 5. Preparation of Fine Superlow-Ash Coal

The Fuqiang Integrated Coking Enterprise in Shaanxi used a physical concentration technique involving repeated washing to produce a fine superlow-ash coal with an ash content of about 1.6 percent. The quality characteristics of the coal prepared in small batches by this method were as follows: moisture ( $M_{ad}$ ) 1.65 percent, ash content ( $A_{ad}$ ) 1.65 percent, volatiles ( $V_{ad}$ ) 35.29 percent, carbon ( $C_d$ ) 85.11 percent, hydrogen ( $H_d$ ) 5.26 percent, nitrogen ( $N_d$ ) 1.50 percent, sulfur ( $S_{t,d}$ ) 0.39 percent, oxygen ( $O_d$ ) 6.07 percent, calorific value ( $Q_{gr,d}$ ) 15,129 BTU/p. If the coal is pulverized further, to a size of 200 mesh or smaller, multistage concentration will produce a superfine superlow-ash coal with an ash content as low as 0.67 percent to 0.78 percent. Its quality is close to that of the superfine coal prepared by chemical treatment. This method will be further tested in intermediate and production-scale experiments.

### 6. Conclusions

a. A chemical method of removing minerals from coal by treatment with hydrochloric and hydrofluoric acids is capable of producing a superclean coal with an ash content below 0.8 percent.



b. Superclean coal produced from Rujigou smoke-free coal had an ash content as low as 0.26 percent; that produced from Dongsheng coal had a maximum ash content of 0.8 percent, and that produced from Yanzhou, Lingwu and Xinmi coal had an ash content between 0.56 percent and 0.60 percent.

c. Physical treatment of coal by repeated washing to remove minerals can also produce fine superlow-ash coal with an ash content of about 1.6 percent.

d. Methods of producing superclean coal in China by chemical treatment with acid or by physical concentration are currently in the small-scale experimental stage.

The participants in the experiment included Comrade Jiang Ying [1203 5391].

### State Council Approves Henan Coal Gasification Project

946B0136E Zhengzhou HENAN RIBAO in Chinese  
20 Jun 94 p 1

[Article by Shi Yuanfeng [4258 6678 1496] and Zhang Jinling [1728 6855 1515]]

[FBIS Translated Text] On 16 June, the State Planning Commission was authorized by the State Council to approve the Yima gasification project. The latter half of this year and the first half of next year will be the preparation stage. Construction will begin in the latter half of next year and will take three years to complete.

The Yima gasification project is one of 20 projects identified by the provincial committee and the provincial government in 1992 as projects to vitalize Henan's economy. It is comprised of three construction projects, a gas producing plant, a long pipeline and an urban distribution network. It is designed to use Yima coal as the raw material and to build an on-site gas plant at the Yima coal mine. In the first phase, it will produce 1.2 million cubic meters of standard clean gas per day. In order to lower the price, 290,000 cubic meters will be used to produce chemicals; the remaining 910,000 cubic meters will be transported via pipeline to Luoyang and Zhengzhou for residential use. The project carries a price tag of 1.84 billion yuan. In the second phase, it will produce 2.4 million cubic meters of clean coal gas daily. The pipeline may be extended to Kaifeng, Sanmenxia, Xuchang and Xinxiang.

The project is dependent upon foreign investment and requires the import of advanced foreign technology. Upon completion, it can alleviate the gas shortage problem encountered in major cities. Furthermore, it can significantly reduce the extent of environmental pollution due to direct burning of coal. This project is obviously very beneficial to the growth of Henan's economy. Every year 1 million tons of coal can be converted on the spot which reduces pressure on the railroads. It can produce 332.15 million cubic meters of coal gas yearly. In addition, it also produces a number of

products such as diesel and paraffin. It will significantly raise the level of coal processing technology in Henan.

### Oil and Gas

#### Steady Progress Seen in Tarim Oil and Gas Exploration

946B0112A Beijing RENMIN RIBAO OVERSEAS  
EDITION in Chinese 4 Jun 94 p 2

[Article by Fan Yingli [2868 5391 0448] and Wang Boyu [3769 0130 3482], Xinhua News Agency]

[FBIS Translated Text] Geologists in China continue to make significant finds in the Tarim Basin in southern Xinjiang. Steady progress is being made in the exploration for oil and gas in this giant basin of 560,000 kilometers.

Most of the funds are concentrated in the central desert and northern structural belt. According to an oil expert in charge of exploration of oil and gas in the basin, the discovery of a 100,000-ton oil field, the Tazhong 4 structure, in the middle of the Taklimakan desert in central Tarim in 1992 is the most encouraging result. Last year, high-yield industrial gas wells were found at Tazhong 6 and Tazhong 10 near Tazhong 4. They form a 40-kilometer-long oil and gas belt from east to west together with Tazhong 4 and Tazhong 1 found five years ago. This also illustrates a bright prospect for turning the 330,000-square-kilometer Taklimakan desert into major oil fields.

In addition, oil was found at eight sites in three structural belts in northern Tarim. A number of high-production gas wells were drilled. This shows that it is equally encouraging to discover major oil fields in the region.

Today, five oil fields in northern and central Tarim are being explored for pilot production. As of the end of last year, a total of 3.23 million tons of oil had been produced, with 1.60 million tons produced in 1993. It ranked 11th in 1993, up from 16th place the year before. In 1994, Tarim is scheduled to produce 2.1 million tons of oil and will be one of the 10 largest oil fields in China. Furthermore, a 197-kilometer-long oil pipeline from the Lunnan field, the earliest oil field exploited, to Korla has been completed. More than 160 kilometers of the first paved highway across the Taklimakan desert has been completed as well.

#### Foreign Firms Begin Exploration in Tarim Basin

946B0112C Beijing RENMIN RIBAO OVERSEAS  
EDITION in Chinese 11 Jun 94 p 1

[Article by Gao Xinhua [7559 5281 5478], Xinhua News Agency: "Foreign Companies Begin to Explore Tarim"]

[FBIS Translated Text] Foreign oil companies that won bids for oil exploration have begun to work in the desert.

In an interview with the Xinhua News Agency, vice president Zeng Xingqiu [2582 5281 3808] of the China Oil and Gas Exploration Corporation pointed out that exploration work is under way in zones 1, 2 and 4 in the southeastern Taklimakan desert.

The total area of the three zones is 38,765 square kilometers. The companies involved are Agip, Exxon, and British Petroleum. They are conducting phase 1 exploration as specified in their contracts.

China set aside five parcels in the southeast Taklimakan desert, 72,300 square kilometers in total area, to accept open bids from foreign companies; 68 companies from 17 countries submitted bids. After a rigorous review and evaluation process, a consortium of 14 companies won the bidding. Two oil contracts and a geological survey agreement were reached and signed at the end of last year.

Zeng Xingqiu expressed his satisfaction about the results of the first round of bidding. He indicated that Tarim is a harsh working environment and the exploration work is highly difficult in nature. In view of the fact that oil prices are not very attractive at the present time, the fact that such a large number of oil companies participated in the bidding is a clear sign that foreign oil companies, banks and investors are very encouraged by the long-range prospect of oil and gas exploration in China.

#### **Tarim Exploration Making Steady Progress**

946B0117A Shijiazhuang *HEBEI RIBAO* in Chinese  
27 May 94 p 3

[Article by reporters Fan Yingli [2868 5391 0448] and Wang Baiyu [3769 0130 3842]]

[FBIS Translated Text] Urumqi, 26 May (XINHUA)—Chinese petroleum geology workers have made a string of major discoveries as oil and gas exploration is stepped up in the 560,000 square meter Tarim Basin of southern Xinjiang Uygur Autonomous Region.

These discoveries are concentrated largely in the central desert region and northern structural belt of the basin. The petroleum experts who are in charge of oil and gas prospecting report that, in 1992, a 100-million-ton oil field was found ready for exploitation in the Tazhong No. 4 structure of the inner Taklimakan Desert of the central basin, the most encouraging find to date in the basin. Last year, the Tazhong No. 6 and No. 10 structures near the No. 4 structure each turned up high industrial-grade oil and gas flows, which, together with the Tazhong No. 1 and No. 4 discovered five years ago, form a 40-kilometer east-west alignment of oil and gas fields, signaling the existence of a huge range of oil fields covering up to 330,000 square kilometers of the Taklimakan Desert, exceeding all expectations.

Meanwhile, on the three northern structural belts of the Tarim Basin, eight new oil-bearing structures have been

found that have yielded high-output oil and gas wells, proving that prospects are good for finding a large oil and gas field there as well.

At present, five oil fields are being opened up for test production in the northern and central parts of the basin with a cumulative annual production capability of 2.1 million tons of crude oil. By the end of last year, a total of 3.23 million tons of crude oil had been produced, more than 1.6 million tons of which were produced in 1993, which elevated its ranking among Chinese oil fields, from 16th place the previous year, up to 11th place, and this year's plan calls for 2.1 million tons of crude oil, which will lift it into 10th place. The 197-kilometer full-scale oil pipeline from Lunnan oil field, the first to be opened up, to Korla is now completed and operating. More than 160 kilometers of the black-top highway, the first to traverse the Taklimakan Desert, have been completed and the road now reaches deep into the central desert.

#### **Breakthrough in Deep Drilling at Zhongyuan**

946B0117B Zhengzhou *HENAN RIBAO* in Chinese  
9 May 94 p 1

[Article by Qiu Guoqiang [0092 0948 1730] and Huang Xijing [7806 6932 2529]]

[FBIS Translated Text] The Meng-4 well, a natural gas forecasting well in the eastern part of the Dongpu depression in the Zhongyuan oil field, having undergone pressure-fracture reformation, has set a new production record of 101,100 cubic meters of natural gas per day. It is the first deep-drilled exploratory well in the western depression of Zhongyuan oil field to get a high-flow output. This breakthrough heralds the excellent potential for deep drilling for natural gas at Zhongyuan oil field.

The Meng-4 natural gas exploration well was drilled in February 1992 down to a depth of 4,500 meters. Last September, after the oil field arranged for S&T personnel to conduct a "collective diagnosis" on this natural-gas forecasting well, a pressure-fracture reformation was carried out and it gave forth a huge natural gas flow from strata below 3,500 meters. The success of this well sets the conditions for increasing the volume of natural gas produced at Zhongyuan oil field.

#### **Dagang Shallow Well Hits Industrial Flow of Crude**

946B0129B Beijing *RENMIN RIBAO OVERSEAS EDITION* in Chinese 25 Jun 94 p 1

[Article by reporter Man Wuejie [3341 1331 2638] and correspondent Liu Guoan [0491 0948 1344]]

[FBIS Translated Text] Tianjin, 23 June (XINHUA)—China's first foreign-cooperative shallow well, the Zhaoqing contract sector C-1 well in Dagang oil field, hit an industrial oil flow on 18 June.

The C-1 well, the first exploratory well undertaken cooperatively between the China National Petroleum and Natural Gas Corporation and the U.S. (Lu An) Corporation, is located in 3-meter shallows, 12 kilometers off the coast. Drilling for this exploratory well, which was designed for exploration down to 3,000 meters, began in mid April and was completed on 30 May. The work was done by the Bohai No. 7 drilling vessel.

The source of the flow is an oil layer 7.5 meters thick and 1,313 to 1,350.5 meters below the site of the C-1 well. Tests show the daily output of crude oil to be 49.5 cubic meters. There are nine oil layers in a lower segment of this well that are still being measured.

Following the announcement that 410,000 square meters of prospecting area in 10 provinces were being opened to foreign cooperation, the China National Petroleum and Natural Gas Corporation signed a 30-year full-risk contract with the U.S. (Lu An) Corporation for the Zhaodong sector of Dagang oil field and the contract went into effect in May 1993. With both sides working closely together the 200-kilometer two-dimensional traverse seismic survey, originally set for three years, was completed in only one year.

#### Natural Gas Potential in Chishui Area, Guizhou

946B0132A Chengdu TIANRANQI GONGYE  
[NATURAL GAS INDUSTRY] in Chinese Vol 14 No 3,  
25 May 94 pp 5-10

[Article by Li Bozhong [2621 0130 1813], Yang Chuanzhong [2799 0278 1813], and Song Kaihui [1345 7030 6540], Guizhou Petroleum Headquarters, Yunnan-Guizhou-Guangxi Petroleum Exploration Agency: "Long-Range Prospects and Approaches for Natural Gas Exploration in the Chishui Region, Guizhou"; manuscript revised 20 May 1993]

[FBIS Translated Text]

#### Abstract

The Chishui region of Guizhou is located on the southern edge of the Sichuan Basin. To date, only the Wanglong and Taihe gas fields and one gas-bearing structure have been identified, and there have been no breakthroughs in gas prospecting. Recently, the combined study of geologic, drillhole, gas field development, and physical prospecting data has shown that the region potentially has a much more extensive area suitable for exploration, containing new gas fields that should greatly expand the area's known natural gas reserves and output. The evidence includes the following. Sediments up to 10,000 m thick, containing many sequences of excellent oil and gas parent rock, whose gas content is tentatively estimated to be 200 billion m<sup>3</sup>, occur in the area. The area is located on the slopes of the Caledonian Qianzhong Rise and the Indo-Sinian Qihuzhou Rise, which favors the migration and accumulation of gas. The area

includes both east-west and north-south oriented structures, as well as abundant concealed structures, and 19 traps have already been identified.

Drillhole data indicate that the region is a complex gas-containing area with multiple pressure systems, multiple pay strata, and multiple gas pool types, which should result in a great increase in known reserves of natural gas and in gas output. Drillholes have produced gas showings throughout the geologic section from the Silurian to the Jurassic, and many concealed gas-bearing strata still remain to be discovered. Jurassic and Cretaceous rocks occur at the surface, and claystone strata are abundant in the depths, favoring the persistence of gas pools. It is concluded from this evidence that expanding the range of exploration in the Wanglong-Taihe structure zone and focusing on the low-amplitude structure area in the south of the region offer the potential for breakthroughs in the discovery of natural gas resources.

The Chishui region is located in northern Guizhou. It is in the southern part of the Sichuan Basin, with Jurassic and Cretaceous rock covering an area of 3200 km<sup>2</sup> of its surface; in the southeastern corner, Paleozoic rocks cover an area of 100 km<sup>2</sup>, and it is estimated that the area suitable for exploration is thus 3300 km<sup>2</sup> (see Fig. 1).

Within the area, the stratigraphic sequence is rather complete. The basement consists of the Early Sinian Banxi metamorphic group; the interval from the Sinian to the Middle Triassic consists of marine sediments about 6000 m thick, from which the Devonian and Carboniferous strata are missing; and the interval from the Late Triassic to the Cretaceous consists of continental sediments about 4000 m thick. The total thickness of the sediments is sometimes as great as 10,000 m.

Drillhole prospecting has discovered the Taihe and Wanglong gas fields and the Guandu gas-bearing structure. Although a long period of prospecting has resulted in some progress, owing to historical and other factors, progress has been slow and there have been no breakthroughs in oil production. One way to meet the present increase in demand for natural gas is to expand exploration and increase the known reserves and output of natural gas. Recent interdisciplinary investigations have deepened our knowledge of geologic conditions related to the occurrence of oil and gas in the area; two- and three-dimensional seismic prospecting has brought to light a group of traps, fault blocks, and faults; and hidden strong seismic anomalies and suture-related anomalies have been found in the existing gas fields on the Taihe and Wanglong structures, which have expanded the size and potential of the area suitable for gas exploration and offered the possibility of discovering new gas fields or pools. In this paper, we shall concentrate on discussing long-range prospects and approaches in the exploration for natural gas.



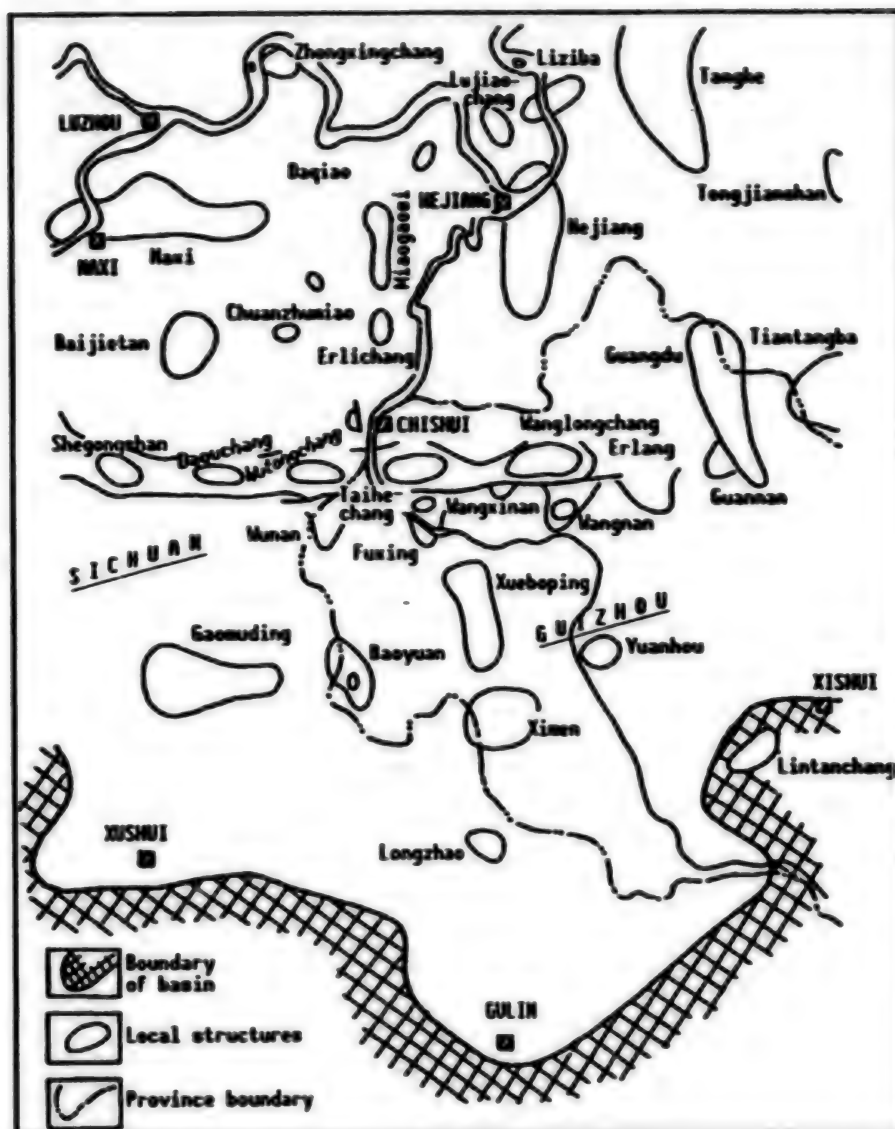


Figure 1.

### Long-Term Exploration Prospects

#### 1. Abundant Gas Reserves, Great Exploration Potential

In accordance with current standards for evaluating the hydrocarbon generating potential of rocks (organic carbon content: more than 0.4 percent of pelitic rock, more than 0.1 percent of carbonate rock), the rock in the area in which exploratory wells have been drilled contains multiple sequences and includes multiple rock types, with abundant organic matter. The potential parent rock includes saprolitic, sapropelic, and mixed types.

Parent-rock sequences occur in both the Upper and Lower Paleozoic, and there are many parent sequences

in the geologic section as a whole. The principal hydrocarbon parent rocks are the Ordovician Wufeng Formation and the Silurian Longmaxi Formation of black saprolitic pelitic shales, with a total thickness of 150 to 300 m, containing 0.4 percent to 6.3 percent of organic matter.

Some 1317 m of the Silurian sequence has been explored by wells. The lower black pelitic shales, which are up to 300 m thick, have very good oil-generating potential. Lower Cambrian black carbonaceous mudstones 200 to 300 m thick that contain 0.5 percent to 1 percent of organic matter are also important as parent rock. The Lower Permian and Triassic Jialingjiang Formation of mixed calcareous hydrocarbon parent rocks has a total

thickness of about 450 m and contains 0.61 percent to 0.08 percent of organic matter. The Lower Permian parent rock is chiefly gray to gray-black Qixia pelitic limestone, about 30 to 40 m thick, which contains 0.19 percent to 0.61 percent of organic matter. The Upper Permian Longtan Formation of sapropelic pelitic mudstone contains an interval of coaly hydrocarbon parent rock. The mudstone is 30 to 70 m thick; the coaly sequence is about 1 to 4 m thick and contains 11.52 percent to 1.02 percent of organic matter. The organic matter in the region has everywhere reached a high degree of maturity. The parent rock in the interval from the Jurassic to the Early Tertiary has entered the dry gas stage, and no liquid hydrocarbons are found in the area. Thus, prospecting efforts should concentrate on natural gas. The Chishui region has an excellent geological basis for the generation of natural gas, and the unexplored supplies of gas are very large. They are tentatively estimated to be more than 200 billion m<sup>3</sup>. Currently, exploratory wells have been drilled only in the top intervals of the Taihe and Wanglong structures. The explored reserves represent only 0.75 percent of the total supply and only 2.88 percent of the reserves in traps; these figures indicate the abundance of the gas reserves and the great potential for their exploration.

## 2. Conditions Favoring Greatly Expanded Natural Gas Exploration

The occurrence of structures in the region and the trap conditions indicate that there is great potential for natural gas prospecting. The Caledonian depression between the Qianzhong Rise and the Longnusi Rise contains thick hydrocarbon parent rocks; the Deyun movement at the end of the Ordovician produced the Qianzhong Rise, and the Chishui region was on the slope of the rise, which favored the accumulation of Lower Paleozoic oil and gas. During the Early and Middle Indo-Sinian the region was located on the upper south-eastern slope of the Luzhou Rise, and it is estimated that a large fraction of the rock contained natural gas. From the Late Yanshan to the Xishan period, folds and buried faults were produced, giving rise to the present-day structural pattern. At the surface, the folds are evident but there are few faults; there are two groups of two to four positive structural lines, running from north to south and east to west (Fig. 1).

The superposition and combination of the north-south and east-west groups of structural lines has produced numerous traps both at the surface and underground. Geological and seismic explorations have already identified 14 local traps, and remote sensing has identified one anticlinal structure (the Gaozhu structure) and four ring structures, for a total of 19 structural traps. Seismic sounding has located 11 buried traps, whose area (at the top of the Yangxin Series) is 239 km<sup>2</sup>. This indicates that the area suitable for exploration within the region is extensive. But in the past, little exploratory effort was made, so that the degree of exploration of the area remains low and no breakthroughs have been made. The

small extent of exploration stands out most clearly in terms of seismic and drillhole prospecting: the area controlled by seismic profiles is only about 23 percent of that suitable for near-term prospecting, and the average exploratory well density is only about eight per thousand km<sup>2</sup>.

The only traps on which exploratory wells have been sunk are the Taihe, Wanglong, and Guandu structures, representing 17.6 percent of all known trap structures and 27.2 percent of those suitable for the drilling of exploratory wells. About 90 percent of the wells are near the summits of the Taihe and Wanglong structures. Thus, there is a pressing need to make a significant exploratory effort in the area, to bring exploration work up to full speed, and to expand the area in which prospecting for natural gas has been performed, so as to make breakthrough progress as soon as possible.

## 3. Potential for a Great Increase in Both Known Reserves and Output of Natural Gas

The Chishui region is complex, with multiple pressure systems, multiple pay strata, and multiple gas pool types, and has great natural gas potential. The pay strata are laterally persistent but are highly variable in their characteristics, and the output of gas wells can be limited by high-permeability zones. Vertically, there are many groups of reservoir strata, and when wells are drilled, gas showings such as gas streams, gas infiltration, upsurges, leakage, and unloading occur through the entire interval from the Silurian up to the Middle Jurassic lower Shaximiao Formation.

Test wells have demonstrated the importance of two major sets of reservoir strata in the region. The first consists of the Jia IV<sup>1</sup>-Jia III<sup>1</sup> member (T<sub>j4</sub><sup>1</sup>-T<sub>j3</sub><sup>1</sup>), the Jia II<sup>3</sup> member (T<sub>j2</sub><sup>3</sup>) and the Jia II<sup>1</sup>-Jia I member (T<sub>j2</sub><sup>1</sup>-T<sub>j1</sub>) of the Lower Triassic Jialingjiang Formation. They consist of pulveritic dolomite and oolitic dolomite and limestone and range in thickness from 10 to 30 m. The explored reserves of these strata in the Taihe and Wanglong gas fields represent 63.8 percent of total explored reserves.

The second stratum is the Maokou (P<sub>1m</sub>) reservoir stratum of the Permian Yangxin system. The reservoir rock consists of sparitic coccolitic limestone and bioclastic limestone. The explored reserves of this group in the Taihe and Wanglong gas fields represent 35.1 percent of total explored reserves. In these two groups, the most important pay strata are the Jia II<sup>1</sup>-Jia I member and the Maokou Formation, which contain 95.6 percent of currently explored reserves. In addition, the area contains many hidden reservoir strata, such as the Jurassic lower Shaximiao stratum Guandu sandstone structure (J<sub>2s1</sub>), which produced gas showings in well No. 3 on the Guandu sandstone structure and gas seepages in the Wanglong structure; it is possible that commercial gas flows will be obtained from it in the low-amplitude structure area in the southern part of the region.

Of the spontaneously flowing wells drilled in the Yuemiao biogenic limestone ( $J_{dy}$ ), cement channeling has been used on the Tai 15, Wang 5, and Guan 1 wells, and gas is issuing from the surrounding space. In addition, the Guan 3 well has produced an aftereffect gas seepage. The Upper Triassic Xujiache sandstone formation ( $T_{3x}$ ) produces gas leakages everywhere on the Taihe and Wanglong structures; the Guan 2 well produced a gas and water upsurge and the Guan 3 well produced a gas stream and in tests yielded 4475 m<sup>3</sup>/day of gas.

The Middle Triassic Lei 1' member ( $T_{2l_1'}$ ) of the Leikoupo Formation, consisting of pulveritic karst dolomite, produced abnormal gas logs in the Wang 6, Wang 3, and Guan 2 wells; after acid treatment and hydrofracturing, the Wang 7 well produced 28,000 m<sup>3</sup>/day of natural gas. The Jia V member ( $T_{3j_5}$ ) of the Lower Triassic Jialingjiang Formation, consisting of pulveritic dolomite, has produced leakages, gas seepages, and even gas and water flows in many wells. DST [drill stem testing] with a 4mm perforated plate in the Jia V member of the Wang 9 well yielded 6667 m<sup>3</sup>/day of gas, and there is a possibility that in the low-amplitude structure zone it may prove to be a major reservoir stratum.

The Upper Permian Changxing Formation ( $P_{2ch}$ ), consisting of micritic oolitic limestones, has produced gas showings in the Tai 12 and Tai 9 wells; it is producing gas in the Zhu, Lu, Rong, and Ba regions of neighboring southern Sichuan and is regarded as a reservoir stratum with long-term promise. Shoal and reef limestones of the Silurian Shiniulan Formation ( $S_{1sh}$ ) in the southern part of the Chishui region also merit attention. The geologic section in the Chishui region contains numerous reservoir strata, and the size of the exploration area in plan is extensive, which offers the potential for increased reserves and output. The currently explored reserves are limited to pressure-drop reserves in the principal pay strata (Jia II'-Jia I, Maokou Formation) at the tops of the Wanglong and Taihe structures. The extensive surrounding area contains abundant resources, and further exploration may lead to breakthroughs.

#### 4. Excellent Conditions for Preservation of Natural Gas Pools

The nature of the cap rock and the ease of hydrologic communication have a major influence on the accumulation and persistence of gas pools [2]. The cap strata of the Chishui region have excellent sealing properties and there is little lateral hydrologic communication, so that conditions are far more favorable for the preservation of gas pools than in other regions of Guizhou.

The cap strata include both regional strata and immediate cap strata. The regional cap stratum consists chiefly of Jurassic argillaceous mudstone, while the immediate cover strata of the gas pools include primarily, Triassic Jialingjiang claystone and dolomitic claystone, the mudstone cap rock overlying the gas pools of the Feixianguan Formation ( $T_{1f}$ ), and the Upper

Permian mudstone cover with an intercalated coaly sequence overlying the Yangxin (Permian,  $P_1$ ) gas pools. Lithologically, there are three types of cap rock: claystone, mudstone, and argillaceous siltstone. Certain cap rock sequences cover large areas, often extending over the entire region; other than the claystone, they are from tens to hundreds of meters thick, and they are located at favorable depths, usually between 1000 and 2500 m.

In 51 gas fields in the Chishui and Southern Sichuan regions [3], 22 Lower Triassic Jialingjiang Formation gas pools are associated with claystone cap rock and 22 Permian Yangxin gas pools are associated with Permian mudstone cap rock; their combined gas content represents more than 80 percent of total gas reserves in the 51 gas fields, which indicates excellent cap rock sealing conditions. Physical and mechanical testing of cap rock cores indicates that on the scale of cap rock sealing characteristics, the cap rock occurring in the region falls in three categories (see Table 1).

The claystone cap rock has the lowest porosity and permeability, the highest breakthrough pressure, the smallest breakthrough radius, and the best sealing factor, and thus has the best sealing characteristics; it is assigned to class I. The argillaceous siltstone cap rock has the highest porosity and permeability, the lowest breakthrough pressure, the greatest breakthrough radius, and the lowest sealing factor, and its sealing characteristics are thus rather poor; it is assigned to class III. The mudstone cap rock is intermediate between the other two types and belongs to class II. The Chishui region differs from other regions of Guizhou by having not only regional cap rock, but also claystone and mudstone immediate cap strata. This superposition of the regional cap strata and the immediate strata produces multilayer sealing, which is excellent for the preservation of gas pools.

The Chishui region has a rather pronounced subdivision of the geologic section into groundwater zones. It is calculated from hydrochemical data that the natural groundwater exchange zone is at a depth of up to 780 m and that the strata from the Triassic down are in the zones of slow water exchange or stagnation. The chlorinity of the ground water is between 16,000 and 28,000 mg/liter and the total salinity is 28 to 47 g/liter, and the water is of the calcium chloride type, which indicates that there is little hydrologic communication and that the conditions favor the preservation of gas pools. The Chishui Depression is relatively close to the southern outcrop area of the Sichuan Basin, and there is a possibility that lateral transport by surface runoff may have occurred. It is clear from the hydrochemical data that the conditions are similar to those of the great majority of gas fields in the southern Sichuan region (Table 2).

In addition, the formation pressures are far higher than the static water head in the outcrop zone (for example, -1165 m in the gas cap of the Wanglong  $T_{3j_1}$  sequence), with an original pressure of 28.4 MPa, compared with



Table 1. Main Physical and Mechanical Characteristics of  
Cap Rock in Chishui Region

Characteristic	Lithology of cap rock		
	Claystone	Mudstone	Argillaceous siltstone
Permeability, $\mu\text{m}^2$	$<10^9$	$10^9-10^7$	$10^7-10^6$
Porosity, %	0.2-0.5	0.5-1.5	1.5-3.0
Breakthrough pressure, $10^5$ Pa	$>740$	200-100	100-80
Breakthrough radius, nm	$<1.8$	5-10	10-15
Sealing height, m	$>8000$	3000-2000	2000-1000
Sealing factor, %	$>17$	5-3	3-2
Pressure resistance, MPa	15-30	25-40	25-40
Plasticity factor	3-2	2-1.5	2-1.5
Sealing ability	Best	Excellent	Fair
Class	I	II	III

Table 2. Characteristics of Groundwater in Chishui and  
Southern Sichuan Regions

Structure	Well number	Stratum	Chlorinity, mg/liter	Salinity, g/liter	Water type
Gaomuding		$T_{1j3}$	47,351	81.9	calcium chloride
Wutongchang	3	$T_{1j2}^3$	16,904		sodium sulfate
Wanglong	6	$T_{1j2}^1$	25,524	44.4	calcium chloride
Taihe	7	$T_{1j1}$	24,000-25,000	44-48	calcium chloride
Shengongshan		$T_{1j1}$	18,397	34.7	magnesium chloride
Tanghe		$T_{1j1}$	20,316	39.9	magnesium chloride
Taihe	4	$P_{1m}$	17,000-18,000	29-30	calcium chloride
Wanglong	8	$P_{1m}$	25,000	42.1	calcium chloride
Yanggaoshi	9	$P_{1m}$	19,988	33.71	calcium chloride
Hejiang		$P_{1m}$	13,516	23.36	calcium chloride
Laowengchang		$P_{1m}$	11,817	21.52	calcium chloride
Fujiamiao	22	$P_{1m}$	23,355	38.84	calcium chloride

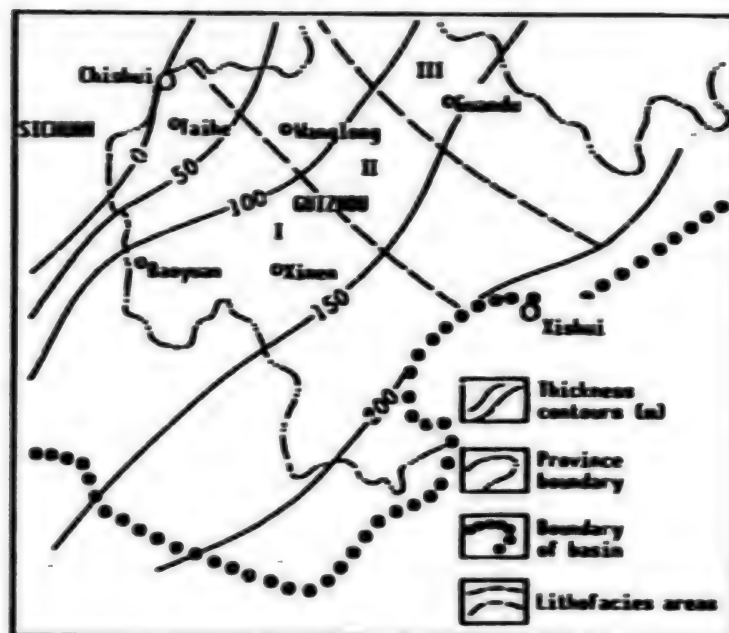


Figure 4.

+400 m at the water surface of the hydrographic network in the outcrop zone); in addition, there are no signs of changes in water characteristics or pressure characteristics related to hydrologic sealing conditions with increasing distance from the outcrop region. The Longzhao structure in the southernmost part of Chishui region is 15 to 17 km away from the outcrop area and the Baoyuan and Ximen structures are more than 20 km away from it. The chlorinity of water from the Jia IV<sup>1</sup>-Jia III<sup>3</sup> member recently sampled from the Bao 1 well is 23,528 mg/liter, with a total salinity of 43.8 g/liter, indicating that this member is already in the zone of stagnant groundwater exchange and that sealing conditions are excellent. Thus, the fresh water of the outcrop area in the southern zone has very little effect on the Chishui region, and there is very little lateral hydrodynamic transport of material. Thus, hydrologic conditions are highly favorable for the persistence of gas pools.

##### 5. Excellent Natural Gas Prospects in the Leikoupo Formation

In March 1991, when the Wang 7 well on the Wanglong structure reached the Lei I member ( $T_2J_1^1$ ) of the Middle Triassic Leikoupo Formation, an upsurge occurred in the well at depths of 1275.0-1278.6 m (drilling with plain water), producing an outflow of water followed by a stream of gas and water. The chlorinity of the water was between 22,100 and 34,639 ppm, and standard one-point drill stem testing obtained 8338 m<sup>3</sup>/day of gas. After acid treatment and hydrofracturing, a yield of 28,000 m<sup>3</sup>/day was obtained. In 1992, tests of the Lei I<sup>1</sup> member ( $T_2J_1^1$ ) in the Wang 9 exploratory well produced gas. After the Wang 7 well had struck gas in the Lei I<sup>1</sup>

pool on the eastern crest of the Wanglong structure, it was demonstrated in production well No 1 on the eastern crest of the Wanglong structure that the Lei I<sup>1</sup> member had a continuous lateral distribution on the Wanglong structure and constituted a pay stratum. Investigations have shown that the Leikoupo Formation in the Chishui region consists of a relict, denuded weathered stratum with a remaining thickness between 0 and 210 m; its thickness increases from NW to SE (Fig. 4).

The Leikoupo Formation includes two members, the Lei I<sup>2</sup> member and beneath it the Lei I<sup>1</sup> member. The lower part of the Lei I<sup>2</sup> member consists of mudstone, argillaceous dolomite, fine argillaceous dolomite, and limestone. The Lei I<sup>1</sup> interval is the reservoir interval and consists chiefly of dolomite and limestone, with a maximum thickness of 65 m. Based on the lithologic characteristics of the Lei I<sup>1</sup> interval, it can be subdivided into three main lithofacies areas (Fig. 4). Area I (the dolomite facies area). Located SW of a line from Taihe to Ximen, consists chiefly of dolomite. The northern part of the region consist of pulveritic dolomite, but oolitic dolomite gradually becomes predominant toward the south. The maximum thickness is 25 m (at Lianghekou, Gulin), and porous strata occur in the middle and upper parts of the interval, with a maximum thickness of 20 m. In many areas the Taihe structure has been truncated as far as the middle of the Lei I<sup>1</sup> member, and there is very little likelihood that porous strata occur extensively. Area II (the mixed dolomite-limestone facies area). Includes the Wanglong and the Guandube area of Xishui. In this area the limestone and dolomite intervals are of about equal thickness, and the stratigraphic

column contains many porous intervals, primarily in dolomite near its junction with limestone. They are most abundant in the middle and upper parts of the section. The Lei I<sup>1</sup> member in the Guandue region of Xishui contains 5 porous intervals with a combined thickness of 16 m, all in dolomite. In the Wang 3, 4 and 6 wells, the porous sequences are 4 to 6 m thick and all occur in the middle and upper parts of the sequence. It is presumed that porous intervals become much more abundant in the southern part of the area and that their thickness increases, thus improving reservoir conditions. Area III (the limestone facies area). Consists primarily of limestone. Porous strata occur primarily in the middle and upper oolitic dolomite intervals. The reservoir space in the Lei I<sup>1</sup> member includes intergranular solution pores, intercrystalline solution pores, and very large intercrystalline solution voids. The porosity is high, exceeding 8% in thin sections, and well logging indicates a porosity of between 8% and 30%. The permeable space includes intergranular pore throats, intercrystalline pore throats, and cracks. The pore structure consists of coarse pores combined with large pore throats, or of coarse and fine pores combined with medium pore throats, and the reservoir characteristics are excellent. In the Wang 7 well, for example, the reservoir space consists primarily of very large intercrystalline solution voids; intercrystalline pore throats are also abundant, and the rock constitutes a good reservoir stratum. It appears likely that on the Wanglong structure and certain other structures to the south of it, the Leikoupo Formation contains gas over a significant area and is a promising target for prospecting.

### Prospecting Approaches

#### 1. More Thorough Exploration of the Wanglong-Taihe Structure Area as the Key to Increased Reserves and Output

In the northern part of the Chishui region, the Wanglong-Taihe structure area, which runs from the Sichuan-Guizhou border south to the Wanglong-Taihe concealed fault, covers an area of 200 km<sup>2</sup>. It includes two major structures, the Wanglong and Taihe structures. Although these structures have been developed, exploration has been concentrated in an area of about 40 km<sup>2</sup> near the crests of the two structures, and a large area suitable for exploration still remains. Recent digital seismic prospecting studies have identified new faults, fault blocks, and traps. Special processing of some of the seismic profiles also revealed some new low-velocity anomalies and amplitude anomalies. More thorough prospecting may well reveal additional fracture zones suitable for exploratory drilling. The explored reserves in the Taihe and Wanglong gas fields are only 2.88% of the total reserves present in traps, and thus great amounts of resources are yet to be exploited. If new high-permeability zones can be found in the extensive area surrounding the crests of the two structures, there is a possibility of identifying new recoverable reserves and of

using the sets of equipment on the existing gas fields for further production, thus achieving a significant increase in gas output. Thus, more thorough exploration is the key to increasing gas reserves and output.

#### 2. The Key to Major Increases in Reserves During the Short Term: The Southern Low-Amplitude Structure Area

The area of low-amplitude structures in the southern part of the region, which extends from the Wanglong-Taihe concealed fault southward to Guilin, eastward to Tucheng and Yuanhou, and westward to Baoyuan, covers an area of 1800 km<sup>2</sup>. It represents 54% of the total area suitable for exploration in the Chishui region. But very little of it has been explored: exploratory drilling is now under way only on the Baoyuan structure. Local structural traps are abundant in the area: 5 anticlinal traps and 5 concealed fault noses have been identified, and further exploration is expected to locate other structures. The five anticlinal traps are largely intact and are not disrupted by major faults in the direction of the strike. In the last 2 years, 2- and 3-dimensional seismic prospecting has been completed in the Baoyuan, Fuxing, Wunan and Wangnan areas, and subterranean structures have been located, so that conditions are ripe for exploratory drilling. The exposed strata in the southern part of the area are relatively new and there are abundant strata suitable for exploration. In addition to the Yang III<sup>3</sup> and Jia I-Jia II<sup>1</sup> main pay strata, there are also shallowly buried strata between the Jia V member and the Leikoupo Formation and a Mesozoic continental porous sandstone reservoir (T<sub>3</sub>x, J<sub>2</sub>s) that warrant exploration. Most of the local structures in the region are located simultaneously on E-W and N-S structural lines. The resulting two sets of strains promote the formation of multidirectional, multigroup crack systems, which further improve reservoir characteristics. The conditions for persistence of gas fields in the area are good, there is little hydrologic communication, the thickness and depth of burial of the regional cap rock and immediate cap rock are favorable, and they have good sealing characteristics. The principal target strata are located at favorable depths and are well suited for exploratory drilling. Excellent gas showings have been obtained on the Baoyuan structure, which is now being explored. The Bao 1 well has found gas pools in the Jia V (T<sub>1j2</sub>), Jia IV<sup>1</sup>-Jia III<sup>3</sup> (T<sub>1j4</sub><sup>1</sup>-T<sub>1j3</sub><sup>3</sup>) and Jia II<sup>1</sup>-Jia I (T<sub>1j2</sub><sup>1</sup>-T<sub>1j1</sub>) members, and well tests have obtained commercial flows of gas, thus demonstrating that the southern low-amplitude structure zone has excellent exploration prospects. This is the key area for major increases in gas reserves and output during the near term.

#### 3. Increased Exploration of the Eastern Low-Amplitude Structure Area in Preparation for the Ninth 5-Year Plan

The eastern low-amplitude structure area includes areas totaling 1200 km<sup>2</sup> to the east of the two structure areas described above, in which the Guandu gas-bearing structure has already been found. Tests of the Guan 3 well in



1989 obtained gas in the Xujiahe Formation ( $T_3x$ ), indicating that the Mesozoic rocks within the region have definite exploration potential. The Leikoupo Formation ( $T_2l$ ) has a remaining thickness of 120 to 160 m in the area, and gas showings have been found during the drilling of wells on it; it too is an important target stratum. The conditions for the preservation of gas pools in the area are good; hydrographic communication is limited, and the regional cap rock and immediate cap rock have excellent sealing characteristics. Comparative analysis of drilling results and well logging data suggests that the principal reservoirs are not greatly different from those on the Taihe and Wanglong structures, and it is forecast that prospecting in this area will be fruitful. But because its geologic conditions are complex, very little exploration work has yet been done. In particular, the accuracy of the seismic data is poor. The only seismic exploration has been a small amount of multiple-coverage curved profiles, and the geologic structure of the region is not well understood. Geological and seismic exploration must therefore be stepped up during the Eighth 5-Year Plan, including 2- or 3-dimensional seismic prospecting, in order to identify subterranean structures and faults. Integrated geological investigations should be intensified and promising features for exploratory drilling should be identified as a basis for exploration during the Ninth 5-Year Plan.

#### 4. Good Long-Term Prospects in the Southeastern High-Amplitude Structure Area Merit More Investigation

This area is in the southeast corner of the region and is part of the North Guizhou Platform Folded Belt. It has an area of 100 km<sup>2</sup>. A 1:200,000 geological survey and general 1:500,000 gravimetric and magnetometric surveys have been performed. The Lintanchang structure, whose axis is oriented toward the NE, has been identified. Its enclosed area is about 50 km<sup>2</sup> and the height of the enclosure is 500 m. The core of the structure is the

exposed Yanchi system. The Mesozoic and Upper Paleozoic intervals present no interest for exploration, but the Lower Paleozoic strata are at a relatively shallow depth, and it is calculated that the base of the Silurian is at about 1500 m. The shoal- and reef-facies limestones of the Silurian Shiniutan Formation and the Cambrian and Sinian carbonate rocks are possible joint-and-fissure reservoirs which have definite long-range exploration potential. Interdisciplinary geological investigation of these strata should be begun. The Sinian interval of North Guizhou has some oil and gas exploration prospects [4]. Investigation and exploration of this region will be important in providing guidance for the exploration of the Lower Paleozoic of northern Guizhou and will also be important for the exploration of the Ordovician and Silurian sequences in the Chishui and Southern Sichuan regions.

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